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THE EUROPEAN TRADITION OF FREEDOM

As the Marshall Plan for Europe takes shape, the question of the future design of Western Europe grows more acute and urgent. No longer is it possible to avoid the challenge which this Plan, and also the course of events in Eastern Europe, are throwing down to those nations of Western Europe which recognize the value of the European tradition of freedom. We have indeed to consider as a matter of urgency whether the United Nations is not already an inadequate instrument in view of the breach between east and west in Europe, and whether it can yet be modified or strengthened to serve the purposes for which it was designed; or whether on the other hand we must seek other means of securing peace and upholding the freedom and great cultural and spiritual values which we have inherited in the civilization of Western Europe.

It is to this problem that Sir Harold Butler addressed himself in his book "Peace or Power" before the Marshall Plan was announced, and it is also the theme of publications issued by the Design for Freedom Committee*, which appeared later. One of them, "Design for Europe", urges that the ideal of world unification which has steadily developed through the past century should be given effect so far as possible by the free nations of the world, and that new machinery should be developed for this purpose by all those nations which are willing to co-operate in giving effect to the ideals of world government.

There can be no accommodation between the ideas of the liberty of man and the slave State, and accordingly the Design for Freedom Committee concludes that the ideal of a single world organisation is at present impossible. Proceeding to analyse the alternatives, it is urged that the only real obstacles to world unity which exist to-day lie in the realm of thought; within the ranks of those who demand human liberty there is no justification for the erection of artificial distinctions and divisions, in the economic, cultural or political spheres. It is suggested that the free world includes all those countries in which Roosevelt's Four Freedoms are regarded as good and desirable; the British Empire, the United States, France, part of Latin America, the Scandinavian countries, Holland, Belgium and Luxembourg, resurgent Italy and Switzerland. Greece is a battlefield where the issue is still at stake. But as a first step, it is urged that a Monnet Plan is required for Europe as a whole, and this as a first condition of giving effect to the Marshall proposals by freeing European trade.

It is suggested that those countries which wish to benefit from American financial help should without delay accept the general principles of the "Proposals for an International Trade Organisation", although the European Plan itself may constitute the special circumstances which provide justification for new preferential arrangements requiring an exception to the provisions of the agreement. Next, those countries must undertake that, as a condition of participation,

* "Design for Europe." Pp. 24. "The New Courageous." By John Maude. Pp. 16. (Design for Freedom Committee, 22 Chester Square, London.) 1*s.* each.

they will not raise their tariffs or impose quotas on some particular range of goods. The Plan should also provide for some form of free trade over European waterways and railways, at least for the right of passage of goods in bond across one country to their destination. Some super-national administration will be necessary for the funds made available by the United States, involving limitation of sovereignty to the extent of seeing that the conditions are enforced. Although this is economic in intent, its consequences are bound to be political, and something beyond the administration contemplated in the European Recovery Programme proposed to Congress by President Truman on December 19 may therefore well be required.

These conditions fall short of the United States of Europe urged by Mr. Churchill at Zurich in September 1946, though they are broadly in line with the actions which President Truman suggested in the recovery programme each country should pledge itself to take. That programme indeed goes further, suggesting pledges to increase industrial and agricultural production, to take the necessary measures to stabilize currency, establish or maintain a proper rate of exchange, make efficient use of the country's own resources, as well as of the goods and services made available through the United States aid, and stimulate the production of specified raw materials; these undertakings are so plainly questions of self-interest to the country concerned that failure to give and to honour them is tantamount to a confession of bad faith. "Design for Europe" does not hesitate to touch bluntly on issues that have been kept rather in the background, and is a stimulus to the thinking that should be proceeding throughout Europe.

It is well that it should be remembered that domestic policy cannot be pursued without regard to its international implications; policies which hinder the immediate creation of an international organisation in which the genuine confidence of all the nations of the free world can straightway be placed are dangerous and reactionary. No satisfactory economic plan for Europe can be devised without some sacrifice of sovereignty on the part of the nations concerned, nor can we expect others to make this sacrifice if we are not equally prepared to do so. The same condition applies to that close association of the British Commonwealth and the United States of America for which the Design for Freedom Committee believes the condition of the world calls. Recognition of this need is at least as important as the attempt now being made to obtain a degree of unity in Europe, for any scheme of European unification will eventually break down if it is not underwritten by joint Anglo-American action.

Here then we find the value of a further Design for Freedom publication, "The New Courageous", by John Maude. In it the emphasis is laid on the things that government cannot provide, and the challenge to the moral qualities of the ordinary citizen that the situation offers. Not merely harder work and lower standards of living are demanded of us, but also higher standards of co-operation and friendship between all men. The wisest and most courageous leadership cannot supply the things of the spirit upon which, above all, the happiness of a people depends; it can only help to provide the conditions in which the individual citizen has the best chance to achieve the health, security and leisure out of which his own exertions can build a full and satisfying life.

Mr. Maude rightly stresses the need for leadership, local as well as national; but his pamphlet is above all a call to face the fact that recovery will be arduous in the extreme and will require personal sustained exertion and the moral qualities which can make a people great. It is these same moral qualities which provide the firm basis of Anglo-American unity as much as of European unity, whether in the form immediately presented to us, or ultimately in the United Nations Organisation, or the Federal World suggested by Clarence Streit. These ideals may be remote, but they are not impossible if we match them with the courage and vision which illuminate the Marshall Plan, and refuse to allow narrow interests to stand in the way of a new approach to Europe's needs.

Although it is different in scale and scarcely reaches the nobler plane of his earlier work "The Lost Peace", Sir Harold Butler's recent "Peace or Power"* reflects much the same spirit. The larger part of the book reviews briefly but incisively the course of events from the armistice of 1918 to the outbreak of war in 1939, and then the trend of events in Europe since the German surrender. Sir Harold is at pains to discern the real causes of the conflict between east and west; and, like the Design for Freedom Committee, he finds it has deeper historical roots than just a clash between communism and democracy. It is a clash between the free ideals of Western civilization and the authoritarian ideals of the East.

Sir Harold argues that the way to perfection cannot be through hatred, intolerance, injustice, tyranny and misery, by whatever names they may be disguised, or by whatever sophistry they may be excused. But the suggestion that the conflict between democracy and communism is not so much an affair of ends as of means is open to question. All the evidence at present goes to show that the police State is poles apart from the Four Freedoms and the whole tradition of Western civilization of which Sir Harold himself is no mean exponent. His discussion of recent changes in Central European and Slav countries scarcely maintains the level of his chapters on "The German Reckoning", "The British Price for Victory" or "The American Impact". Although he rightly stresses the dominant importance of the agrarian problem, his treatment of Russia in Europe is sometimes superficial and tends to overlook the earlier contacts of Russia with Byzantium and with Europe through the Hanseatic league. None the less, on the vital issue he is unequivocal; and although he recognizes that parliamentary democracy is fatally compromised in the greater part of Eastern Europe, he believes that Western democracy —the willing submission of the minority to the majority in the confidence that its submission will not be abused—provides the only approach to peace. In that, moreover, is involved a more positive and

* Peace or Power. By Sir Harold Butler. Pp. 269. (London: Faber and Faber, Ltd., 1948.) 15s. net.

constructive conception of democracy such as is implicit in the Marshall offer and the European Recovery Programme put forward in the United States.

In the national democracies, survival depends upon the response of their citizens to the new conception of positive duties and to the ability to train men and women to accept and discharge those responsibilities of citizenship. So too, as Mr. Middleton Murry has pointed out, the survival of world society depends upon an equally new conception of the positive duties of one nation to another in the economic sphere and in the maintenance of the world's peace. We may fairly claim that Britain has been a pioneer of positive domestic democracy; but we should also be prompt to recognize in the American offer to Europe that the United States is the pioneer of positive international democracy, and to match her vision and generosity with vigorous, prompt and radical action. The challenge is, indeed, to wring from destiny a peace which only men of good will can achieve; and the success of that plan—the issue of peace or power—depends supremely on whether Britain and Europe can find the men of good will.

One need look no further than to the study by Mass-Observation entitled "Peace and the Public"* to realize how immense is the task of creating an informed and intelligent public opinion on international affairs, or the dangers inherent when a general intangible desire for peace is accompanied by ignorance of what is involved, and a disposition to lay the responsibility for action on others.

The question of peace or power is fundamentally one of men, of values and of positive measures, and as such it touches the man of science closely. Leaving on one side the implications and the urgency which the advent of nuclear energy and atomic warfare has brought to the situation, in the conception of positive democracy he has already played a large part, as Dr. Julian Huxley has shown in his little book "Democracy Marches" and later in "T.V.A.—Adventure in Planning". Moreover, if, as Dr. Huxley emphasizes, freedom of speech, of opinion, of discussion, of belief, and of research are vital to a democratic society, the man of science must accept some responsibility for safeguarding them. In General Smuts' words, "Europe has been the spiritual home of the west, the source of our concepts of progress, liberty and all the other basic ideas of our higher life . . . Europe is the heart of the cause of man, and her decadence would mean an immeasurable loss to all that is most precious in the human heritage". None the less, the challenge of Soviet Russia to the civic and personal liberties at stake all over Europe must be met by positive achievement, by the proof that the great traditions of the past—the heritage of freedom—can supply the mainspring for fresh advances, creative thought and the effective service of the changing needs of man. That, too, depends on the co-operation of the man of science. Whatever he can do to spread more widely the scientific outlook and an appreciation of what is implied in the scientific method will fortify his fellow citizens against the dangers of propaganda.

*"Peace and the Public." A Study by Mass-Observation. Pp. vii + 58. (London: Longmans, Green and Co., Ltd., 1947.) 2s. 6d. net.

DOCUMENTATION OF ORGANIC CHEMISTRY

Elsevier's Encyclopædia of Organic Chemistry

Edited by E. Josephy and F. Radt. Series 3: Carboisocyclic Condensed Compounds. Vol. 13: Tricyclic Compounds. Pp. xx + 1265. (New York and Amsterdam: Elsevier Publishing Co., Inc.; London: Cleaver-Hume Press, Ltd., 1946.) £25 17s.; to Subscribers to Series 3, £22 2s.; to Subscribers to Whole Work, £19 7s.

LIKE most other sections of the community, organic chemists have their peculiar worries. One perpetual cause for concern is the increasing difficulty of finding, in easily accessible form, complete and up-to-date information about results of research on individual compounds or in particular fields. The older original literature is well indexed and fully summarized, but the task of compiling the standard indexes and reference works has not kept pace with the accumulation of new knowledge. Publication of the fourth edition of Beilstein's "Handbuch der organischen Chemie" began at about the same time as the reviewer's chemical career—that is, more than a quarter of a century ago. With its first supplement, this fourth edition completes the survey of the organic chemical literature only up to the end of 1919. Several volumes of the second supplement have been published, and if all goes well with plans now being made this supplement will be complete in 1952. By then, therefore, the literature up to the end of 1929 will have been covered; but the advances of the intervening twenty-three years will have no adequate and comprehensive summary.

It is against this background that Elsevier's "Encyclopædia of Organic Chemistry" must be regarded, for there is no doubt that it is intended as a serious competitor to "Beilstein", and that it claims superiority to "Beilstein" in certain important respects. The "Elsevier" scheme provides for the issue of twenty volumes of the main work, which is arranged as four series. Vol. 14, the first to be issued, has already been noticed in these columns (*Nature*, 160, 626; 1947); it deals with tetra- and higher-cyclic compounds. The volume now under review is concerned with tricyclic compounds; it is to be followed shortly by vol. 12 (bicyclic compounds), subdivided into 12*A* (excluding naphthalene) and 12*B* (naphthalene compounds). Vols. 12, 13 and 14 together comprise Series 3 of the whole work (Carboisocyclic Condensed Compounds). Other volumes besides 12 are apparently to be subdivided, as it is stated that the entire work will consist of approximately thirty-eight parts. The price of the complete work will place it beyond the reach of individuals, and it is clearly intended for libraries and research institutes. But the arrangement of material is such that each volume is largely self-contained, and many organic chemists (and even physical chemists) will wish to obtain for their own bookshelves selected volumes or perhaps a series. The present volume, dealing *inter alia* with fluorene, acenaphthene, anthracene, phenanthrene and their derivatives, will be invaluable to those with a special interest in compounds of these classes. The largest section, dealing with anthracene and its derivatives, comprises 590 pages, excluding indexes, and is a treatise in itself. It contains an excellent modern survey of the bibliography of anthracene and anthraquinone, and their derivatives.

Future parts of the "Encyclopædia" are scheduled to appear at six-monthly intervals, and the plan provides for the completion of the whole work by 1963. Each volume is to include all the original literature of the compounds within its purview, up to four years prior to its date of appearance. Supplements are also to be issued, each ten years after the respective part of the main edition.

This is an ambitious scheme and a formidable undertaking, about which many searching questions will be asked. Will it be possible to adhere to the proposed time-schedule ? Does the system of classification facilitate rapid reference ? Is there justification for the publisher's claim that the "Encyclopædia" gives "complete information on all chemical and physical properties and on the most important physiological properties of organic compounds" ? Is the information absolutely reliable, and are the data accurately transcribed from the original memoirs ? How does the work compare with "Beilstein", and is there a need for both these works of reference ?

"Beilstein" is an established institution in organic chemistry, and has acquired great prestige and a tradition for comprehensiveness and reliability. It will not be lightly discarded in favour of some new and untried publication. "Beilstein" is not completely infallible ; but it is a rare and outstanding achievement to find an error. The chief defects are (*a*) the time-lag which causes much of the material to be nearly thirty years out of date, and (*b*) the cumbersome system of classification, which results in data on closely related compounds being scattered over the entire range of volumes, and makes it sometimes difficult to find the desired information.

It is pertinent to ask what are the prospects of the quality of "Beilstein" being maintained in the future and of reducing the period of induction before new knowledge is available in the "Handbuch". Prior to the War the indexing and preparation of material was carried on in Berlin in direct association with the German Chemical Society, which no longer exists. There was ample accommodation for the work and excellent facilities, especially in regard to the availability of periodicals. A few months ago the reviewer had the opportunity to see the present editorial office at Frankfurt-Hoechst, in the American Zone, and to renew acquaintance with Dr. Richter, the editor. Working conditions fall far short of those formerly enjoyed in Berlin, and if the project to complete the second supplement by 1952 is to succeed there will need to be great improvement in office accommodation, supply of periodicals, etc. Moreover, under present conditions in Germany supplies of paper and publishing facilities are by no means assured for a venture of this magnitude. The outlook is probably not so gloomy as these comments might suggest, as there are powerful and sympathetic interests at work in support of the "Beilstein" organisation, and there is reason for hoping that many current difficulties will be surmounted.

As regards the Elsevier "Encyclopædia", it would be premature to attempt now any final assessment of its completeness and its accuracy. This will be made by the many chemists who will use it during the coming years. At this stage one can give only first impressions from what has necessarily been a somewhat superficial survey. These impressions, as regards the volume under review as also in regard to vol. 14, have been wholly favourable. The reviewer had already had the opportunity of seeing, in 1939, the organisation set up in Amsterdam for the production of this "Encyclopædia", and of meeting the editors, Dr. Josephy and Dr. Radt, both of whom were formerly members of the "Beilstein" staff. Dr. Josephy was 'liquidated' by the Nazis during the occupation of Holland. Dr. Radt, who happily survived the War, had a considerable share in the composition of the first supplement of "Beilstein", and had been entrusted with the direction of the preparatory work for the second supplement. It was clear, therefore, that the preparation of the Elsevier "Encyclopædia" was in very experienced hands, and the extensive array of card indexes in the editorial office bore witness to the immense amount of work already put into the project by 1939.

Vol. 13 is an excellent production. It is admirably printed in clear type, and the text is liberally illustrated with structural formulæ. Throughout the main sections the left-hand page bears at the top the structural formula of the parent compound, with its numbering. Chronological lists of references are given at the end of each sub-section, and at the foot of each page is given, where necessary, the numbers of the pages on which the appropriate references are listed. Many users will find it inconvenient not to have the full reference on the same page as the description of the compound, but the system used probably saves space. Publication was delayed by the War, and the present volume, dated 1946, states that the literature up to and including 1936 has been consulted, and the literature concerning the structure of compounds up to 1947. Certainly the newer work seems to have been noted in cases where important revisions of structure have been made, and there are numerous references to publications of the period 1937–45.

In the preface to vol. 14 it is claimed that all the data from the 231 journals listed have been taken directly from the original journals. Presumably this claim applies also to the list of nearly 270 periodicals given in the present volume. Where abstracts only have been consulted the abstract references are given. The most important omission concerns patent specifications, to which reference is not made. This limits considerably the usefulness of the present volume to chemists who are interested in anthraquinone dyestuffs. Apart from this, the reviewer has looked in vain for errors or omissions. It is claimed that the "Encyclopædia" will list and describe all organic compounds reported in the scientific literature throughout the world. It is not claimed that all references to a particular compound will be mentioned in the entry relating to that compound, and, in fact, this has not been done. In some cases this may lead to confusion. For example, p. 712 gives a structure (in an obsolete form which appears to have been copied from "Beilstein") of 5-diazoanthraquinone-2-sulphonic acid. In the only paper cited in this entry the compound is described as the 1-diazo-2-sulphonic acid, an error which was corrected in a paper published five years later. The reference to the later paper, although it is given in a neighbouring entry in the "Encyclopædia", does not appear under that relating to the diazo compound, and without this reference there is nothing to show why the structure has been modified.

The presentation of the data has been done with great skill, and gives evidence of expert chemical knowledge and sure instinct. Thus, there are apt editorial comments concerning the possible origin of certain bands in the infra-red absorption spectrum

recorded for phenanthrene (p. 789); on the structures of an ether of xanthopurpurin (p. 527), of the nitration product of 2-ethoxyanthracene (p. 279), and of an alleged hexahydroanthracene (p. 518). An attractive feature is the introduction of schemes of formulæ illustrating reactions of certain rather complex natural products such as abietic acid and some related compounds, cedrene, tricyclene and its derivatives, colchicine, thebaine and carminic acid (given as carmic acid); similar schemes show the reactions of the dicyclopentadienes. Extensive quotation of physical constants and references to papers dealing with biological effects of many of the substances will appeal to many users. Space is saved and reference facilitated by describing in tabular form the characteristics of numbers of closely related compounds; for example, the colours of the azo derivatives of anthraquinone-sulphonic acids, and the physical constants of the alkylphenanthraquinones and of the pharmacologically interesting phenanthrylaminoalkyl carbinols.

The arrangement adopted in the "Encyclopædia" aids rapid reference, and groups together hydrocarbons and their various functional derivatives. It has, nevertheless, certain disadvantages. Thus, there are references to tricyclic sesquiterpenes in two widely separated sections of the present volume, and other classes of sesquiterpenes will presumably be included in other volumes. Again, although the tetracyclic sterols and bile acids are properly dealt with in vol. 14, some of their tricyclic degradation products (for example, ætiobilianic acid) appear in the present volume. In other cases the names only are given, with cross-references to volume 14, and this method of treatment, although not strictly logical, is to be preferred. The present volume also includes a number of phenanthrene derivatives obtained by degradation of alkaloids such as morphine and thebaine, corytuberine, glaucine, boldine, laurepukine and artabotrine. The English style of the work is satisfactory, and only very rare lapses betray the Continental origin of the publication. The British reader, for example, will probably be mystified by expressions such as "fat coals" (p. 28) and "brutto formula" (p. 207). There are an excellent subject index and a comprehensive formula index.

In the opinion of the reviewer it is deplorable, in the present state of organic chemical documentation, that the duplication of effort involved in the production of both Beilstein's "Handbuch" and Elsevier's "Encyclopædia" should continue. It would be equally deplorable if the tremendous amount of labour already put into either project should be wasted. What is needed is an amalgamation of the two organisations, with the view of concentrating all the available resources on the rapid completion of an up-to-date comprehensive survey of the organic chemical literature. It is clearly desirable that use should be made of modern methods of punched cards and mechanical sorting systems, in conjunction with a cyphering system such as the elegant and ingenious system of Dyson. Only by the use of every possible device can the herculean task be accomplished. The provision of a complete survey of the literature of all organic compounds is an international service, and the project should be conducted under international sponsorship, provided always that this can be made fully effective, with adequate resources. Organic chemists throughout the world should speak with united voice on the urgent and imperative need for resolute action on these lines. J. W. Cook

PROBITS

Probit Analysis

A Statistical Treatment of the Sigmoid Response Curve. By D. J. Finney. Pp. xiii+256. (Cambridge: At the University Press, 1947.) 18*s*. net.

BOOKS on statistics are apt to be either shallow or obscure. A book which avoided both these dangers and yet covered the whole field would have to be a very long book; but it is possible to achieve both profundity and perspicuity by restricting the scope of the book to the discussion of one technique, and this device has been adopted in a new book by D. J. Finney.

Whatever we may think of its etymology, the word 'probit' (probability-unit) has become firmly embedded. It was introduced by C. I. Bliss to denote a function into which percentages are converted in order to facilitate computation. When the dose of a poison is plotted against the percentage mortality, an *S*-shaped curve is obtained; but when the logarithm of the dose is plotted against the probit of the mortality, the results can usually be fitted with a linear regression line. A report dealing with this technique was published by the Medical Research Council in 1933, but this report has long been unobtainable. In the meantime, the subject has become more complicated, and many biologists and others will welcome the appearance of a complete text-book dealing with the whole subject. The book contains a history of the method, a discussion of its mathematical basis, full details about the use of a calculating machine for working out an example, a large number of other examples with less detail, and all the necessary special tables.

There is also much discussion of the more complex applications of probits, and it is really surprising to see what an elaborate subject this has become. Allowance can be made, by Abbott's formula, for the mortality in control groups of animals receiving no poison, and methods are given for calculating the maximum likelihood solution in this case. When the mortality depends on two factors, such as dose and time of exposure, the results can be interpreted by calculating the probit plane. When two poisons act together, or when one poison acts in two ways, the results will not, in general, be fitted by a straight line, and the shapes of the curves to be expected in this case are discussed. Methods are given for analysing the variance of the sensitivity of the animals when tests are carried out on different days. The case when each animal receives a different dose is discussed. A section is devoted to the general formula proposed by Parker–Rhodes which includes, as special cases, both the normal distribution of individual lethal doses and the normal distribution of the logarithm of this quantity. The last chapter refers briefly to the treatment of the results of tests in which the response of each animal is measured quantitatively, as, for example, when a vitamin is estimated by its effect on the weight of rats.

The book will serve as a valuable guide to this branch of statistics. Everyone who is interested will be able to learn something from it. The novice will find full instructions for making complicated calculations, and even the experts will find things that they did not know before. There is, however, one criticism to be made. In previous writings on this subject the symbol λ has been used to denote the standard deviation of the logarithm of the inde-

pendent variate, such as the dose. This notation was proposed because σ commonly denotes the standard deviation calculated directly, and it is convenient to use a different symbol when logarithms are used. This convention is not necessarily good, but has been widely adopted; it is therefore unfortunate that in this new book the same rather exotic symbol is used to denote the dose. Surely some other symbol might have been found for this purpose.

J. H. GADDUM

DATA FOR NUCLEAR PHYSICS

Nuclear Physics Tables

By J. Mattauch; and An Introduction to Nuclear Physics, by S. Fluegge. Translated from the German by Eugene P. Gross and S. Bargmann. (Published and distributed in the Public Interest with the consent of the Alien Property Custodian.) Pp. viii + 173 + 8 plates. (New York and London: Interscience Publishers, Inc., 1946.) 72*s*.

THIS work combines a comprehensive set of tables of nuclear physics data compiled by J. Mattauch with an introduction to nuclear physics by S. Fluegge. It was first published in Germany in 1941 and has now been republished in the United States by Interscience Publishers.

The first table gives a list of all the measured constants of stable nuclei. This includes relative abundance, spin, magnetic moment, quadrupole moment, and mass defect. The third table gives mass differences for all the important doublets used in the mass-spectrograph determinations of isotopic weights. The fourth table gives a list of all isotopes, stable and unstable, and their isotopic weights with probable errors of the determination. It gives the details of half-life, radiations emitted and method of formation for all radioactive isotopes. This table is specially valuable since it provides in separate columns for the thirteen common methods of formation of radioactive isotopes, (α, p), (α, n), (p, γ), (p, n), etc. It is possible, therefore, to see very quickly all the known reactions, say, of the (n, γ) type or, for example, to look up a specific positron emitter having a positron energy above a desired value. The sixth table gives a list of energy yields (Q values) of a large number of nuclear reactions of atomic number less than 33.

There is finally a chart of the well-known 'wall type' in which all known nuclei are represented by black, red or green squares depending on whether they are stable, unstable or isomeric, while arrows show all possible transitions.

The tables are complete with references, and contain all information available in 1941. Their principal deficiency to-day is in the list of fission products and their properties, most of this information having been released within the last year by the various atomic energy projects.

Information on nuclear absorption and scattering cross-sections is conspicuously lacking, and is a second deficiency. A good deal of this information was available in 1941, and much better and more complete information is now available.

The "Introduction to Nuclear Physics" comprises 109 pages. It includes subjects such as K-capture, isomerism and the meson theory of nuclear forces which have not been available in earlier text-books. Mass spectrographs and methods of calculation of mass defects are treated fully, as are experimental methods of determination of nuclear spin and nuclear moments. The chapter describing methods of observation in nuclear physics, such as ionization chambers, counters and amplifiers, is now out of date owing to the important developments in technique during the war years.

The book, therefore, fills a gap in existing literature in nuclear physics; but it is rather far from satisfying the need for a really comprehensive text-book embodying all the published knowledge now available.

J. D. COCKCROFT

BIOLOGY OF THE LOUSE

The Louse

An Account of the Lice which Infest Man, their Medical Importance and Control. By Prof. Patrick A. Buxton. Second edition. Pp. viii+164. (London: Edward Arnold and Co., 1947.) 10*s*. 6*d*. net.

THE louse (*Pediculus humanus*) is a highly specific parasite of man. Prof. Buxton's book deals with this creature more especially from the biological and medical points of view. It is an insect of great importance in human economy since it is well known to be concerned in the transmission of epidemic, or exanthematous, typhus from one person to another. The epidemic type of relapsing fever is also transmitted by it, as is the disease known as trench fever. The latter malady was a major factor in the health of the opposing armies in the First World War; but its actual or apparent disappearance since its close has yet to be explained.

The new edition of Prof. Buxton's book bears testimony to the great increase in knowledge of the louse since the appearance of the first edition in 1939. Ideas and knowledge of louse control have been well-nigh revolutionized in that interval, particularly owing to the fortunate discovery of the remarkable effects on the insect of the compound known as *D.D.T.* The wide use made of this substance in the great typhus outbreak in Naples in 1944 led to the epidemic being arrested in the course of about half a year. Tens of thousands of persons at one time were treated daily simply by blowing *D.D.T.* as a dust under the garments, without any undressing being involved. Even more effective is the impregnation of clothes with *D.D.T.*, since this compound retains its lice-killing properties after they have been worn for several weeks and repeatedly washed with hot soap and water. It appears that an impregnation of 1 per cent by weight of garments in store with *D.D.T.* enables them to retain their insecticidal properties to a large extent even after a year. As Prof. Buxton remarks, the efficiency of *D.D.T.* in louse control is so great that perhaps we have now seen the last great typhus epidemic.

The study of the collective biology of louse populations has virtually come into existence in the short interval since 1939, mostly through Prof. Buxton's own researches. Also, Wigglesworth's work on the sensory physiology of the insect is a further noteworthy advance in our understanding of its behaviour. These, and many other aspects of the louse in relation to man, are fully dealt with in this authoritative and indispensable little book. Being written with a breadth of viewpoint only to be acquired by a truly scientific outlook, we commend it not only to medical officers but also to entomologists the world over. Another feature is the very complete bibliography of louse lore that accompanies the text of this manual.

A. D. IMMS

The Detection and Control of Garden Pests

By G. Fox Wilson. (Agricultural and Horticultural Series.) Pp. 194+54 plates. (London: Crosby Lockwood and Son, Ltd., 1947.) 12*s*. 6*d*. net.

A GOOD sound book on pests of the garden has long been overdue, and Mr. Fox Wilson's effort certainly fills the gap admirably. Very often insect damage to cultivated plants is uncommonly difficult to identify. Unless it can be recognized in its early stages and measures of repression put into force, it is usually "too late to mend". The book is an expanded and revised version of the author's serial articles entitled "Symptoms of Pest Attack on Plants" published in the *Gardener's Chronicle* during 1932–36. The basis of the book is, therefore, laid on diagnosing pest injuries, and each chapter deals with the insects or other pests of a separate part of plants. Thus Chapter 3 deals with roots, and here the reader will find an account of the injuries inflicted by all the root-enemies that are likely to be encountered. Other chapters deal with stems and shoots, flowers, seeds, and so on. There is no doubt that this method of treating the subject facilitates quick identification better than any method of grouping the different pests under their natural orders or their specific plants.

The measures advocated for the control of the various pests are the best that present-day knowledge can offer—some are completely effective, others partially so. The photographic illustrations of damaged plants are a useful aid together with those of individual pests. While the nomenclature used for different pests is not always very modern, little confusion will result. In fact, it will prove an advantage to the general reader for the reason that it will facilitate reference to works of earlier date, since in these works the older names are current.

The author has done a real service in writing this book at a time when we need to produce and conserve so much in the vegetable kingdom. A. D. I.

The Adjustment and Testing of Telescope Objectives

By H. Dennis Taylor. Fourth edition. Pp. viii+95. (Newcastle-upon-Tyne: Sir Howard Grubb, Parsons and Co., 1946.) 17*s*. 6*d*.

THOUGH the first edition of this work was published more than fifty years ago, in 1891, it still has value as a standard work on the adjustment and testing of telescope objectives. The firm of Sir Howard Grubb, Parsons and Co., which has taken over the astronomical interests of Messrs. Cooke, Troughton and Simms, has performed a useful service in publishing a new edition. This edition follows the text of the third edition, published in 1921. The new edition would have had a greatly increased value, however, if the opportunity had been taken to revise the material thoroughly and to make additions to bring it up to date. New methods of testing objectives are available and might well have been included. The introduction to the volume refers to the refracting telescope as "the most convenient and generally reliable form of telescope"; but since this was written the reflecting telescope has become much more favoured. All large modern telescopes are necessarily reflectors, and reflectors are much used by amateurs because, for a given aperture, a reflector is less costly than a refractor and also because mirror making is within the ability of many amateurs. It would have been valuable to have included an account of methods of testing mirrors—spherical, paraboloidal and hyperboloidal. Other material could with advantage now be omitted as not strictly pertinent to the subject of the book. At some future date, a new edition is likely to be required, and it is suggested that the opportunity might then be taken to make a complete revision.

I fondamenti scientifici della astronomia

Per Prof. G. Armellini. Pp. xv+320. (Milano: Ulrico Hoepli, 1947.) 650 lire.

THE aim of the author in writing this book was to fill a gap in Italian scientific literature by presenting a logical mathematical account of the foundations of that part of astronomy which is concerned with the study of the movements of the celestial bodies, and with the calculation of their distances and of their dimensions. The book is intended primarily for the students attending courses in astronomy at Italian universities, and the knowledge of mathematics required does not go beyond simple applications of the differential calculus. In addition to the ground usually covered in elementary text-books on spherical astronomy, the author deals with the calculation of an orbit from three observations, with the determination of the solar motion, with the rotation of the galaxy and the determination of its dimensions and mass, with elementary stellar statistics and dynamics, with the distribution of the external galaxies and with the curvature of space. Most of the subjects dealt with are necessarily discussed only in an introductory manner. The student who masters this book will, however, have a sufficient grounding to enable him to proceed to the study of more advanced text-books. The author plans to follow this work with a further volume on the scientific foundations of astrophysics, which will be concerned with stellar photometry, astronomical spectroscopy, and the physics of the sun, planets, stars and nebulæ. H. S. J.

Native Peoples of the Pacific World

By Prof. Felix M. Keesing. (Pacific World Series.) Pp. xv+144+32 plates. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1946.) 15*s*. net.

FOR most people there is a strange glamour about the South Sea Islands and their inhabitants, due in part, no doubt, to the works of such visitors as R. L. Stevenson and Gauguin. But few people know anything accurately either about the islands themselves or about the various peoples who live there, their material culture, customs, etc.

This book, written mainly for American soldiers during the War, sets out to supply this need, and it has the great advantage of being written by a specialist; Prof. F. M. Keesing was born in Malaya, brought up in New Zealand, and has been professor of anthropology in the University of Hawaii. He is at present professor of anthropology in Stanford University, California. After a general chapter on the geography of the South Sea Islands, the Polynesians, Micronesians and Melanesians are in turn briefly described, such matters as languages, types of government, methods of livelihood, home conditions and social customs being mentioned. Finally, there is a chapter on religion. The whole is profusely illustrated and the work is very readable. Unfortunately, there is no bibliography; but a beginner interested in these far-away peoples will here find an excellent introduction to the subject. M. C. B.

THE DRAINING OF BINLEY LAKE AND ITS ECOLOGICAL CONSEQUENCES

By WING-COMMANDER T. R. CAVE-BROWNE-CAVE, C.B.E.*

A DESCRIPTION of the formation of drainage channels in the mud exposed by draining a large lake and the exceptionally rapid growth of vegetation on the lake bed may be of some general interest. The work was done for camouflage during the War.

A large expanse of water is the most outstanding landmark seen from the air at night. To an airman who knows how to approach it from the correct quarter in suitable conditions of light, it will shine out in sharp contrast with the general darkness of the landscape. A few miles to the east of Coventry is Binley Lake, some 90 acres in extent, and of a most distinctive horse-shoe shape. It would be an invaluable landmark to an enemy approaching a target so far from the coastline. It was therefore decided, after consultation with the Air Staff, to drain the Lake in order to suppress its outstanding appearance.

The Lake contained a great quantity of coarse fish, and the owners derived very considerable revenue from fishing. But their co-operation was prompt and most helpful. A stream flowed into one end of the Lake. Water passed out through sluices so placed that the Lake would drain without difficulty when they were fully opened. Arrangements were made with the Fishery Board of the area to net the fish and transfer them to streams and reservoirs in the neighbourhood. The experts who did the work estimated that they successfully decanted nearly a million fish, ranging from pike of more than 20 lb. to bream of about 20 gm. The netting process necessitated lowering the water-level very slowly. When most of the important fish were out, the last of the water was released. That left ninety acres of flat wet mud which would shine and reveal the distinctive shape just as well as the water would have done. Even if the bed did dry out during the summer, it would return to its wet brilliance after every heavy rain storm. It was considered that not until the mud was well drained and aerated after several seasons would there be any strong growth of vegetation. The mud was very soft and 4–6 ft. deep. Any work of artificial drainage would have been almost impossible. There was, however, such a complete absence of those drainage channels which appear in mud flats left by the tide in an estuary that it seemed worth while to arrange for another 'tide', which ebbed more rapidly.

The Lake was allowed to refill to a depth of some 12 inches. The sluices were then opened wide, so as to get the maximum possible rate of outflow. In less than two hours, a perfect system of drainage channels started to develop and gradually spread over the whole area in perfect pattern. It was therefore probable that the mud would gradually dry out and would not re-flood, because rain storms would tend to cut the channels deeper. Fig. 1 is from a photograph taken on November 13, 1942, from the outlet sluices, a few hours after drainage was complete.

The site was examined occasionally from the air until it was obvious that the mud had dried so well that there was no risk of shine. It was not until some eight months later—November to July—that a further survey was made. The report was rather surprising, so an examination on the ground was made. The lake bed was completely covered by dense vegetation. Fig. 2 is from a photograph taken on September 22, 1943, from the same point as Fig. 1, but ten months later and in a slightly different direction. The expanse of supposedly waterlogged and sterile mud was covered with a dense growth, including some willows more than 8 ft. high. Presumably the drainage and aeration had been rather better than expected. The crust had hardened sufficiently to allow men to walk across the Lake with circumspection; but there was a pronounced jelly-like movement which suggested the mud underneath.

There can be no doubt of the excellence of the camouflage. The cost of making the change was small. It may be significant that, although Coventry had been heavily raided on two occasions previous to the draining, two raiders which came to that area not long after the Lake was drained dropped their bombs in open country within ten or fifteen miles of the vitally important area.

After the need for camouflage had ceased, the problem of returning the Lake to its owners and determining the extent of compensation arose. Expert advice was taken upon the action which would most promptly enable the lake bed to return to a condition in which the Lake could satisfactorily be

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Fig. 1. DRAINAGE CHANNELS PRODUCED IN THE BED OF BINLEY LAKE

* Of University College, Southampton, late Director of Camouflage.

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Fig. 2. VEGETATION COVERING THE BED OF BINLEY LAKE TEN MONTHS AFTER DRAINING

re-stocked. It was considered that until the Lake was reasonably clear of rotting vegetation, the oxygen content of the water would be too low to justify re-stocking with fish. It was also doubtful whether 6–8 ft. of water would be sufficient to kill the vigorous growth which had arisen during the two years the Lake had been empty.

The owners were therefore advised that the vegetation should be cut close down in the spring, the autumn and the following spring before the Lake was re-flooded. Compensation was based upon this suggestion, and allowance was made for a reasonable period before the Lake and its fish could be expected to have recovered full fishing value. The owners decided, however, not to incur the expense of cutting, and they re-flooded the Lake in October 1944, almost exactly two years after it had been drained.

A visit to the Lake in August 1947 showed that during two seasons a few men had been employed in pulling out the bullrushes and similar growth which showed above the surface. In March 1946 there were large areas of open water with belts of reedmace at the shores. Some eight thousand roach, bream, pike, rudd and tench were then put in; a further seven thousand, with some golden carp, were added in September 1946. All seemed well until in July 1947 a strong growth of hornwort (*Ceratophyllum demersum*) developed in almost every part of the Lake. The growth extended to the surface in many places, where it entrained a quantity of ordinary pond weed and made fishing almost impossible. The fish, however, appeared to thrive. No dead fish have been seen, and those caught show good growth and are in good condition.

The problem now is to find what action can be taken without injury to the fish to avoid the growth of weed in subsequent years.

Dr. W. B. Turrill and Mr. V. S. Summerhayes, of Kew, visited the Lake in December 1943, and a brief summary of their findings is appended.

VEGETATION AFTER DRAINING

By V. S. SUMMERHAYES and Dr. W. B. TURRILL

A visit to Binley Lake was made on December 2, 1943, under the guidance of Mr. F. P. Knight, of the Directorate of Camouflage. The Lake had been drained and its bed was occupied by a dense growth of vegetation fairly uniformly spread over the whole area. The dominant plant was the reedmace (*Typha latifolia*), except in a few small patches where other species (mainly *Phragmites communis* and *Carex* sp.) had obviously established themselves, previous to the draining, in shallow water against the shore. The reedmace plants were up to 6–8 ft. in height, and a very large number of them were in full fruit. Though they were distributed over the whole lake bed, the mature plants of reedmace were somewhat denser in some parts than in others. In places willows (*Salix caprœa* and *S. viminalis*) had become established and were 8 ft. tall. Locally these willows were abundant. The reed grasses *Phragmites communis* and *Glyceria maxima* occurred in a few places, and many marsh and some dry-land species were listed as present in one to several individuals. It was fully established, from the morphology of the *Typha* and other plants, that this remarkable growth of vegetation had occurred within one year. The botanical evidence was in complete agreement with the dated records that the fruiting *Typha* plants had developed from seedlings in less than twelve months, a surprising rapidity of growth from establishment on bare mud.

The vegetation was only partially closed. In many places, leaves of separate plants touched or overlapped, but there was mostly bare mud between individual plants. On this mud were innumerable seedlings of *Typha*, low-growing marsh plants, some in flower or fruit, and mosses. The presence of mosses was not unexpected; but the species represented were mostly well-known dry land ones. Far and away the most abundant was a form of *Funaria hygrometrica*, which sometimes appeared in continuous patches a foot or more square, but more often in smaller clumps. Other species present in fair quantity, but scattered throughout much of the area of the lake bed, were: *Barbula unguiculata*, *B. tophacea*, *Bryum argenteum*, and *Bryum* sp. (barren). Small quantities of *Webera carnea* and *Dicranella heteromalla* were also noticed, and one patch of the liverwort *Marchantia polymorpha* was found near the inlet end of the Lake.

The reedmace which, at the time of the visit, had so largely occupied the mud, must have spread as seeds from near the top (inflow) end of the Lake, where there was an old-established community of this species forming what had evidently been a *Typha* swamp. No other *Typha* was found growing in or near the Lake, except the young plants and seedlings all less than a year old.

PHYSIOLOGY OF DISEASE RESISTANCE IN PLANTS

AT the Royal Society symposium held on December 11 on the "Physiology of Resistance to Disease in Plants", three papers, by Prof. W. Brown of the Imperial College of Science and Technology, Prof. F. T. Brooks of the University of Cambridge and Dr. F. C. Bawden of the Rothamsted Experimental Station, respectively, were read. Unfortunately, there was no time for a general discussion at the end of the papers.

Prof. W. Brown claimed that physiological analysis of the host-parasite relationship is most readily attempted in the case of the facultative parasite. The latter can be cultivated *in vitro* and its metabolism, therefore, studied up to the limits set by available experimental techniques. One can thus obtain some idea of the means by which fungi and bacteria attack plants—the so-called 'offensive mechanism' of the parasite—and conversely of the resistance which plants are able to oppose to such attack. The establishment of parasitism involves the carrying out of a series of operations which will be discussed in the following sequence: (1) pre-penetration phase, (2) the act of penetration, and (3) post-penetration phase.

In the pre-penetration phase the first requisite is that spore germination should take place. The more vigorous the germination the more likely is penetration to occur. Moist conditions, that is, presence of free water or of a sufficiently high relative humidity, are essential, and these must persist for a time sufficient to allow of germination and entrance into the host, otherwise death of the germ-tubes by desiccation would result. Meteorological conditions largely determine whether a particular plant disease can establish itself or whether alternatively it reaches epidemic proportions. Even under wet-weather conditions, some plants are protected from invasion by possessing an unwettable type of surface, so that one of the preliminary conditions for infection is not satisfied. This is an example of 'disease escape', the plant not being attacked even though it may be inherently susceptible.

Granted suitable environmental conditions, the germinative capacity of the spores of any fungus varies with their age and with the conditions of culture under which they were grown. A factor of importance at this stage is the passive exosmosis of solutes from the underlying host cells, and these affect the amount and vigour of spore germination according to their quantity and quality. The presence of other fungi or of bacteria in the inoculum has in general a depressing effect on germination and therefore on the establishment of parasitism. This is an example of microbiological antagonism which is more prominently shown with certain root-invading fungi.

The stimulus to penetration was at one time considered to be of chemotropic nature, but that view has been largely discarded. With fungi which penetrate directly through the cuticle, the stimulus is one of mechanical contact, the germ tubes becoming fixed to the surface of the host by formation of an appressorium (attachment organ), at which point they attempt to penetrate. The mechanism of penetration is also physical, the fungus putting an extremely fine outgrowth through the cuticle. The evidence on this point is partly cytological and partly that no cuticle-dissolving substance is known to be produced by fungi. The mechanical properties of cuticularized epidermis and the intrinsic penetrative capacities of fungi are the determining factors at this stage. A part of cuticular resistance depends upon the hydrostatic backing of the underlying epidermal cells. By these means one can explain the penetration of young or old leaves when the leaf is not penetrable in its mature, fully active condition.

Cuticular resistance is the only means of defence of some plants against specific parasites (wound parasites). Frequently the cuticular barrier is circumvented by invasion through stomata or other natural opening, or by way of parts (for example, the stigmas of flowers) where the cuticle is poorly developed. Once inside the plant, parasites of the facultative type disorganise the host tissue and live on the dead remains. The chief substance concerned in this process is pectinase enzyme. Resistance may take the form of retardation or inhibition of growth of the invader or interference with its offensive mechanism. Thus acidity of cell-sap, or presence of tannins, oils, glucosides, etc., may prevent growth of a potential parasite. A similar effect is obtained when the metabolism of the latter leads to the formation of substances ('staling substances') which by and by inhibit growth; hence the formation of lesions of limited size.

The reaction of the host to the presence of the parasite may be to lay down mechanical barriers (gum, cork) which seal off the lesion. Chemical responses, for example, the localized formation of phenolic compounds, may occur; but it is not clear how far these are effective. It is very doubtful if there is in plant pathology (apart from some viruses) an antigen-antibody type of reaction comparable to what is known in animal diseases.

A more general type of resistance is seen where, in the absence of any obvious anti-fungal property of the plant sap, the plant in its normal condition shows resistance to a fungus which appears to have the necessary offensive mechanism. Slight modifications of the host, as produced by raising its water-content or by previous incubation at a warm temperature, may swing resistance over to susceptibility. Other components of this problem are the differential effects of nutrient upon the capacity of fungi to produce pectinase, and differences in detailed properties of pectinase as derived from various fungi. The continuance or otherwise of attack appears to rest upon the functioning of an intricate enzymic process, the details of which have not been worked out as yet.

Finally, there is a kind of resistance which depends upon insensitiveness of the plant tissue to the enzymic secretion of the fungus. As the primary enzymic effect is hydrolysis of the cell walls, the factor which confers immunity in this case is the chemical composition of the cell wall.

Prof. F. T. Brooks pointed out that the fundamental difficulty met with in studying the physiology of obligate parasites is that the fungus cannot be grown on culture media and thus has to be studied in relation to the host itself. The relationship of host and parasite is bound up with subtle protoplasmic properties of the two organisms, though even here there is some evidence that structural properties of the host confer a measure of resistance; for example, the presence of a greater amount of sclerenchyma in certain wheats, the thickness of the mature cuticle in the barberry leaf which resists penetration by the germinating sporidia, etc. Resistance of cereals to rust attack has long been known to rest upon the

'hypersensitive' effect, invasion by the fungus leading to localized necrosis of the host cells, so that further advance of the parasite is stopped. With the fully susceptible host the rust establishes a kind of common life with the invaded tissue and there is no evidence of mutual antagonism. Intergrades between the two types of reaction occur.

One can do little more than speculate as to the physiological nature of these reactions. It has been suggested that hypersensitiveness arises by the excretion from the fungus of a toxin and that the fungus eventually dies from starvation or more probably through the agency of lethal substances excreted by the host. No satisfactory explanation in biochemical terms is as yet available of the difference between susceptible and resistant host varieties.

The hypersensitive reaction is affected by changes in the environment; for example, by nutritional alterations of the host as brought about by varied illumination or by differential manuring, and even by the presence of another parasite in the tissue. Thus under certain conditions a susceptible host becomes resistant and *vice versa*. Frequently susceptibility in seedling cereal plants gives way to resistance as the plants grow older ('mature plant resistance'). This effect is of great practical importance, but its physiological meaning is unknown.

Resistance to attack by mildews first becomes evident at the stage where a sub-cuticular papilla is formed. Whereas in a susceptible host a haustorium emerges from the papilla to invade the underlying epidermal cell, such emergence does not occur where there is resistance. The host cell is undamaged, though a hypersensitive effect has also been described. A similar range of behaviours is seen in connexion with the invasion of potato varieties by the wart disease fungus, though here the striking response is the large development of gall tissue when the variety is susceptible.

With certain facultative parasites there are defensive mechanisms in resistant hosts which, while not preventing initial invasion, preclude the fungus from spreading extensively in the tissues. Such is the gum barrier produced from wood carbohydrates when a resistant variety of plum is invaded by the silver-leaf fungus. A susceptible variety produces no such protective barrier, though under conditions of enhanced metabolism it may do so to some extent. Resistance to the root-invading fungus, *Armillaria mellea*, also appears to be due in part to the gumming reaction, though here cork barriers are developed in addition. The functioning of cork barriers is well seen in varieties of apple trees resistant to canker; in this case the effectiveness of the barrier is largely dependent upon the state of metabolism of the host, so that under some conditions a normally resistant variety becomes susceptible. The well-known 'shot-hole' appearance in the leaves of many plants is often due to the limitation of the lesion by a cork barrier.

Resistance to wilt-producing fungi appears to arise in a number of ways. With flax-wilt, resistance is seated in the cortex of the roots, so that the fungus is shut off from reaching the vascular bundles. In hop varieties resistant to wilt, the fungus enters the vessels, where it grows much as in a susceptible variety, but no harm ensues. It has always been considered that the wilting effect is due to the formation by the fungus of a toxin, and recently the toxin of tomato wilt has been identified as a polypeptide of known composition. Presumably the resistance of certain hop varieties to wilt is due to the non-elaboration of a toxin, or to insensitiveness of these varieties to the toxin produced. In some cases resistance of plants to wilt appears to be a property of the root only, in others of the whole plant.

Among the few examples in which resistance to fungal invasion is associated with particular substances of known composition, the best known is that of coloured types of onion against certain parasites. In contrast to white varieties of onion, which are susceptible, coloured ones owe their resistance to the presence in their outer scales of catechol and protocatechuic acid.

Resistance is rarely absolute under all conditions. The precise result obtained depends to some extent on the amount of inoculum applied and on environmental factors as affecting both host and parasite. The latter has already been referred to in connexion with resistance of cereals to rusts. A notable example of the effect of temperature on disease response is seen with the scab disease (*Fusarium*) of wheat and maize. Wheat seedlings are susceptible at the higher, maize seedlings at the lower temperature ranges, and in both cases it has been shown that susceptibility is correlated with a pectic type of cell-wall structure, the temperature under which the plants were grown being the determining factor for this.

Dr. F. C. Bawden dealt mainly with viruses. These are unique pathogens, for they are both wound parasites and obligate parasites. All uninjured plants are immune from all viruses, and most viruses have a narrow host range. Thus immunity is the common state, susceptibility is exceptional. Nothing is known of the conditions conferring natural immunity. The growth requirements of viruses are unknown, and though plant extracts often contain virus inhibitors it is uncertain whether these substances function as such *in vivo*. One is, therefore, limited to considering variations in degree and type of resistance shown by susceptible plants.

Viruses rely for transmission on vectors, chiefly leaf-sucking insects, and usually produce systemic infections. Possibly because of their systemic nature, virus diseases provide the only authentic examples of acquired resistance in plant pathology. There are two types, both simulating conditions well known with animal diseases. In the first type, infection leads to severe initial symptoms, from which the plants recover, and then resist effects of further inoculation. The recovery is not because of antibody formation, and the virus is present all the time in the resistant tissues. The second type of acquired resistance simulates the process of vaccination in animals: protection against a severe strain of a virus is given by previous infection with a mild strain. Again there is no antibody formed. Protection is based on mutual antagonism between the two viruses. It is suggested that there are only a limited number of sites of virus multiplication in a cell, and if these are occupied by one strain another cannot become established. The resistance is acquired only against related strains, and unrelated viruses may act synergistically, giving together severe symptoms when each alone gives only mild.

Virulence is not an intrinsic property of a virus strain but a reflexion of a host-parasite interaction, and is not correlated with the concentration of virus reached within the plant. Strains of potato virus *X*, for example, may cause severe diseases in some potato varieties and not in others. Hypersensitiveness, similar to that of cereals to rust fungi, affords a common form of resistance. Sometimes, however,

there is a systemic hypersensitiveness in which the whole plant is invaded and killed. This is the extreme of susceptibility, but confers resistance by eliminating the virus from the stock as a whole. Varieties of potato which react to virus *X* in this way are rarely found infected in the field, whereas other varieties are almost universally so.

Short of hypersensitiveness, intermediate degrees of tolerance occur, down to the condition of 'carrier' varieties which show no symptoms though they may contain a high concentration of virus. The degree of tolerance is somewhat modified by environmental conditions.

With equal chance of infection, a greater incidence of disease occurs in some varieties than in others. This has been demonstrated both in field and controlled experiments. The inference is that different amounts of virus are needed to cause infection in different hosts. Though the evidence from dilution curves is that infection is caused by single virus particles, it seems that different numbers must be introduced into different cells to ensure that one becomes established.

With some viruses infection occurs only when the particles are introduced directly into the phloem; more often introduction into ordinary parenchyma cells is sufficient. The method of inoculation can affect susceptibility, infection taking place more readily when the inoculum includes a suitable abrasive. The severity of the symptoms shown may also be increased by this means.

An effect comparable to the 'mature plant' resistance of cereals to rust fungi is often seen, ease of infection and the severity of symptoms diminishing as the plant grows older. The cultural conditions of the host also influence resistance; thus some viruses are more readily transmitted in winter than in summer. The controlling factor appears to be light, and susceptibility to some viruses is enhanced by keeping the plants in darkness for 24 hours before inoculation. It is suggested that the presence of photosynthetic products interferes with the establishment of virus particles at sites of multiplication. The conditions of mineral nutrition are also important, phosphorus being most effective in increasing susceptibility, though quantitative comparisons are rendered difficult by unequal growth of the plant under different systems of manuring. Increased size of the plant itself tends to favour infection, and conversely small size gives plants a disease-escape mechanism which may simulate resistance in the field. Susceptible plants may also escape infection because they are unattractive to vectors or grow in situations which reduce the chance of visits by the appropriate insects.

CHEMISTRY OF VISUAL PROCESSES

By S. BALL, F. D. COLLINS, Prof. R. A. MORTON
AND
Dr. A. L. STUBBS
Biochemistry Department, University of Liverpool

SINCE rhodopsin (visual purple) was first described in 1876 by F. Boll[1], much evidence concerning its chemical nature and physiological properties has accumulated. Relatively few attempts have been made, however, to devise theories embracing all the facts; the contributions of G. Wald[2], R. J. Lythgoe and his colleagues[3] and R. Granit and his co-workers[4] being outstanding. The objects of the present article are to describe experiments which seem to reconcile divergent findings, as between Wald and Lythgoe, and to provide a basis for discussing in chemical terms Granit's discoveries, concerning the electrophysiology of retinal elements.

It is necessary first to elucidate the decomposition of rhodopsin extracts. Wald[2] stated that retinene$_1$, later shown by Morton and Goodwin[5] to be vitamin A aldehyde, was the final product of bleaching. He was able to extract retinene from retinas freshly bleached by light, or from bleached solutions of rhodopsin, by using as solvent a mixture of acetone, ethanol and light petroleum. The retinene was identified by its ultra-violet absorption maximum 380–385 mμ in chloroform and its colour test maximum (664 mμ) with the antimony trichloride reagent. When a solution of rhodopsin in the aqueous digitonin used to detach the pigment from the retina was acidified before bleaching, the irradiated solution exhibited an absorption maximum at 443 mμ which afterwards disappeared, the final solution having the same general absorption on the long-wave side of 400 mμ as neutral or alkaline solutions. At that time Wald was not able to follow the absorption curves on the short-wave side. It seems clear, however, that he regarded retinene$_1$ as the sole and final product of bleaching rhodopsin *in vitro*.

Lythgoe and his co-workers were also restricted to wave-lengths exceeding about 395 mμ in recording absorption spectra. They observed that in acidified aqueous digitonin rhodopsin gave on irradiation 'indicator yellow' with $\lambda_{max.}$ 444 mμ. In neutral or alkaline solution no maxima (at wave-lengths greater than 395 mμ) were observed. Lythgoe concluded that indicator yellow was the final product of bleaching rhodopsin; he suggested that it was a conjugated protein with $\lambda_{max.}$ 444 mμ shown only in acid.

A. C. Krause[6] obtained a fraction from bovine retinas which exhibited $\lambda_{max.}$ 444 mμ in acidified ethanol and 360 mμ when the solution was made alkaline. Krause obtained his materials from freshly bleached retinas rather than from rhodopsin solutions, and his findings are not strictly comparable.

The work carried out in our laboratory confirms and extends the observations made by both Wald and Lythgoe. Thus in neutral solutions rhodopsin bleaches to a substance exhibiting $\lambda_{max.}$ 380 mμ and on which extraction by means of an ethanol – light petroleum mixture yields retinene$_1$ ($\lambda_{max.}$ 385 mμ in chloroform, 664 mμ with the Carr–Price reagent). In acid solution, bleached rhodopsin shows $\lambda_{max.}$ 440 mμ, and in alkaline solution $\lambda_{max.}$ *c.* 360 mμ. In neither case is any absorbing material extracted by means of ethanol – petroleum mixture provided the *p*H is sufficiently different from 7. The substance giving rise in acid to the 440 mμ maximum is unstable even in the dark, and the final product is devoid of selective absorption. No retinene$_1$ can be extracted at that stage even after neutralization.

Further experiments have been carried out using pure retinene$_1$ obtained[7] by the oxidation of vitamin A. When dissolved in 1 per cent aqueous digitonin, pure retinene shows $\lambda_{max.}$ 380 mμ, and the spectrum is unaffected by changing the *p*H of the medium. If, however, retinene$_1$ dissolved in aqueous alcohol or 1 per cent digitonin is mixed with one of the following: (*a*) an aqueous extract of bleached retinas,

(*b*) a dialysed aqueous extract of choroid, (*c*) a solution containing a suitable protein, or (*d*) a solution containing a suitable amino-acid, absorption maxima at 440–460 mμ appear on acidification, or at 360–380 mμ in alkaline solution. The following proteins gave a positive result: egg albumin, trypsin, edestin, peptone. Gelatin, casein, zein and pepsin gave negative results. Of all the amino-acids tried, only β-alanine gave $\lambda_{max.}$ 440 mμ in acid solution. Arginine, aniline, *o*-toluidine, *o*-phenetidine hydrochloride, *p*-toluidine, diphenylamine and *p*-aminobenzoic acid all gave maxima at 500–525 mμ in acid solution. The reaction with *p*-aminobenzoic acid is interesting because the product responsible for the 535 mμ maximum is decomposed by light, and the consequent decrease in absorption at 535 mμ is accompanied by a rise at 390 mμ. Some interaction occurred between retinene$_1$ and the following, but was not accompanied on acidification by such marked changes in absorption: *d*-*iso*leucine, glycine, tryptophane, tyrosine, glutamic acid. Little or no effect was obtained with α-alanine, benzoic acid, dimethylamine, benzylamine, serine, benzoxazolone, pyridoxine, riboflavin, leucoriboflavin, phenol.

The conclusion to be drawn concerning 'indicator yellow' is that free or loosely bound retinene$_1$ (the final product of bleaching rhodopsin) may combine with any suitable protein or amino-acid which may be available. In that case 'indicator yellow' would be a fortuitous artefact having no direct relevance to visual chemistry, and Wald's cycle[2] connecting vitamin A retinene and rhodopsin need not be complicated by trying to fit in 'indicator yellow'.

Granit and his colleagues have greatly advanced the study of visual processes by the use of the microelectrode for picking up electrical impulses from optic nerve fibres subserving illuminated rods and/or cones. By using monochromatic light and measuring threshold intensities needed to obtain responses from rods or cones, action spectra can be arrived at.

At this point it is necessary to emphasize the distinction between an action spectrum and an absorption spectrum (cf. Dartnell and Goodeve[8], Hecht[9], Wald[2]). Granit[4] makes clear the distinction between equal energy and equal quantum action spectra. If I_0 is the incident intensity and I the emergent intensity of light of wave-length λ passing through unit area of 'retina' containing n absorbing molecules, $\log_{10} I_0/I = kn$, k varying with λ. If I_a is the intensity of absorbed light $I_a/I_0 = 1 - 10^{-kn} = a$, that is, fraction of light absorbed, and

$$100\, a\, \lambda/a_{max.} = 100(1 - 10^{-kn})/(1 - 10^{-k'n}) = \alpha.$$

Putting D for $k'n$ ('optical density' at $\lambda_{max.}$) and E for 100 $kn/k'n$, $kn = ED/100$ and

$$\alpha = 100\ \frac{(1 - 10^{-ED/100})}{1 - 10^{-D}},\ \text{or}$$

$$E = \frac{100}{D}\ \log\left(\frac{1}{1 - \frac{\alpha}{100}\ (1 - 10^{-D})}\right).$$

Plotting α against λ gives the action spectrum, and E against λ the absorption spectrum, α being the light absorption of wave-length λ expressed as a percentage of the absorption at $\lambda_{max.}$ and E being the extinction expressed as a percentage of $E_{max.}$ (D). When D is small, $E \simeq \alpha$; but action spectra and absorption spectra are not identical at higher values of D, thus:

VALUES OF E FOR DIFFERENT VALUES OF α AND D

α	D 0·01	0·05	0·1	0·2	0·3	0·5
20	19·8	19·2	18·2	16·7	15·2	12·8
50	49·7	48·6	47·1	44·2	41·5	36·3
80	79·8	79·0	78·1	76·0	73·7	68·8

Although the differences between α and E are very unlikely to vitiate any of Granit's findings, they may well become significant when comparisons between absorption spectra *in vitro* and his action spectra are used to try to trace the origin of the latter.

Granit's data imply the existence of a scotopic dominator (substance), the action spectrum manifested agreeing closely with the absorption spectrum of rhodopsin. A photopic dominator (substance) and several modulators must also be postulated. The dominators function in the perception of brightness and the modulators in colour discrimination. Evidence suggesting a chemical relatedness of the substances responsible for both dominator and modulator spectra emerges from the comparison of the data on eyes in which vitamin A (rhodopsin, retinene$_1$) occurs, and eyes in which vitamin A$_2$ (porphyropsin, retinene$_2$) is present (ref. 4, p. 290). In the two systems, corresponding absorption spectra and action spectra show parallel displacements. Bliss[10] recently recorded the extraction of retinene$_1$ from a solution of the photopic pigment iodopsin. It thus seems probable that vitamin A and its aldehyde occupy a key position in photopic and scotopic vision alike.

The action spectra of Granit's dominators correspond closely with the absorption spectra of rhodopsin and 'iodopsin'[11,12], $\lambda_{max.}$ 500 mμ and 560 mμ respectively. His modulators would correspond with much narrower absorption bands which have not hitherto been accounted for chemically. It seems that at least three chemical species must be postulated with narrow absorption bands in the visible region; they must be derived from a precursor (or precursors) available in the retina and they must have very special properties. The readiness with which vitamin A and retinene give rise to deeply blue-coloured solutions with antimony trichloride in chloroform, and the sharpness of the bands shown, coupled with the transient nature of the blue materials, suggest that with suitable environmental conditions retinene might give rise to ionized or halochromic molecules[12] resembling Granit's modulators.

It has been found that when vitamin A or retinene$_1$ is dissolved in concentrated sulphuric acid or syrupy phosphoric acid at temperatures near 0° C., coloured solutions are produced which exhibit well-defined selective absorption with maxima corresponding rather closely with Granit's maxima.

The absorption bands of the solutions derived from vitamin A and retinene$_1$ are narrower than those implied by Granit's action spectra. The solutions are sensitive both to light and heat, and in the 'fading' processes the maxima fall at different rates, suggesting the presence, not of one product with several bands, but of several products with one maximum to each. Although light hastens the fading, the solutions are not nearly so sensitive to light as are rhodopsin solutions.

WAVE-LENGTHS OF MAXIMUM ABSORPTION $\lambda_{max.}$ IN mμ

Rhodopsin		500				
Iodopsin				560		
Dominators		500		560		
Modulators	450–465	500	520–530		580–610	
Vitamin A in conc. H_2SO_4	465		530		590	620*
Vitamin A in conc. H_3PO_4	440–480		520		600	
Retinene$_1$ in conc. H_2SO_4	440–460		520	560		664*
Retinene$_1$ in conc. H_3PO_4	470	500		550	590	

* Shown better with the antimony trichloride reagent.

The conditions under which modulator analogues have been produced are obviously unphysiological. In the complete absence, however, of evidence for modulator precursors other than vitamin A and retinene$_1$ in rhodopsin eyes, the potentialities of these substances need to be explored. If it be granted that a *prima facie* case has been made out, the next and more difficult task will be to establish the physiological methods for stabilizing the modulator analogues.

It may be suggested tentatively that the greater width of Granit's modulator curves compared with the absorption bands of the analogues is consistent with a greater optical density of the modulators in cones than of rhodopsin in dark-adapted rods. Since the optical density varies as the product of molecular extinction coefficient and concentration, either or both could be important. The large difference between the thresholds of scotopic and photopic vision is well established; the quantum efficiency of the photo-decomposition of rhodopsin is nearly unity, and the molecular extinction coefficients of the modulator analogues are very high, but the substances fade less quickly than rhodopsin. The quantum efficiency of photochemical decomposition of modulators should thus be very low.

The photopic receptor substances, presumably conjugated proteins, may then be present at cone surfaces at relatively high optical density; they must be relatively thermostable as otherwise there would be a spontaneous sensation of light[14]; and finally, once detached from the protein moiety, halochromic or ionized prosthetic grouping derived from vitamin A or retinene would yield materials known to be present in retinas.

The special difficulties which are met in the study of photopic receptors make it important to pursue the study of the porphyropsin–retinene$_2$–vitamin A_2 system, because comparison of the rhodopsin–porphyropsin systems at all stages may be fruitful. The visual systems of invertebrates having eyes lacking either vitamin A_1 or A_2 present a further problem.

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[3] Lythgoe, R. J., *J. Physiol.*, **89**, 331 (1937).
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[6] Krause, A. C., *Amer. J. Physiol.*, **140**, 40 (1943).
[7] Ball, S., Morton, R. A., and Goodwin, T. W., *Biochem. J.*, **40**, *Proc.* lix (1946).
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[14] de Vries, Hl., *Nature*, **161**, 63 (1948).

OBITUARY

Dr. A. L. Du Toit, F.R.S.

THE death of Alexander Logie Du Toit on February 25 has removed a particularly interesting figure from the stage of international geology. Born in South Africa on March 14, 1878, he received his early education at Bishop's College, Cape Town, whence he proceeded in turn to the Royal Technical College, Glasgow, and the Royal School of Mines, South Kensington. His connexion with Scotland is recalled by an important paper on Old Red Sandstone and Highland Border rocks, communicated to the Edinburgh Geological Society in 1902. Most of his researches, however, concern his home country, South Africa. At one time or another he held official positions on the Geological Survey and Irrigation Department of the Union; and later, in private practice, he acted for De Beers Consolidated Mines. In 1925 he led a government expedition to the Kalahari. His text-book, "The Geology of South Africa", published in Edinburgh in 1926, is indispensable to students of the subject, and includes welcome chapters on soil and economics.

In geology, as in astronomy, workers in the southern hemisphere have much that is special to tell their comrades of the north, because they look in a different direction. The southern continents, including India, are so closely comparable in their late Palæozoic and early Mesozoic histories that Suess long ago separated them from the rest of the world under the name Gondwanaland. In 1910, F. B. Taylor, and in 1912, A. Wegener, advocated continental drift on a scale that would account, without intervening subsidence, for the present apparently scattered distribution of the components of Gondwanaland. Du Toit had visited Australia by the time he learnt of the new hypothesis; and now, not content with further comparisons based on reading alone, he persuaded the Carnegie Institution of Washington to send him across to South America. Here, in Brazil, Uruguay and the Argentine, during the latter half of 1923, and with generous support from the local governments and geologists, he was able to accomplish a remarkable amount of field exploration, and to master the very difficult relevant literature. The results are set out in a Carnegie Institution publication entitled "A Geological Comparison of South America with South Africa" (1927). The treatment shows little mercy to readers, who have to stagger on under the impact of strange geographical and stratigraphical names; but the impression is conveyed that a path has been blazed through a hitherto impenetrable jungle. The author himself entertains no doubt as to the drift separation of South America and South Africa. He maintains the same outlook in "Our Wandering Continents" (1937), where a gallant attempt is made to rewrite the whole of world geology.

To turn to quite another aspect of the man, it is worth recording that among his friends Du Toit laid claim to the faculty of dowsing.

The Geological Society of London honoured Du Toit with the Wollaston Fund in 1919, and the Murchison Medal in 1933. These awards were fittingly bestowed during the presidencies of G. W. Lamplugh and Thomas Holland, who successively had learnt much of South African geology during visits of the British Association in 1905 and 1929. Du Toit was elected a fellow of the Royal Society in 1943.

E. B. BAILEY

NEWS and VIEWS

Czechoslovakia

WITHIN a few weeks of receiving the honorary doctorate of Brno University which bears his father's name, Dr. Jan Masaryk passed away at the age of sixty-one, on March 10, in tragic circumstances. Born and educated in Prague, he would not claim to have been a man of science, though he fully appreciated the importance of science in world affairs. He had occasionally taken part in scientific and cultural discussions and conferences while in Great Britain and elsewhere. Many philosophers and men prominent in various sciences were among his numerous friends, and he was always ready to help students and others whenever an opportunity occurred, whether it was in connexion with the exchange of scholarships or of scientific literature. Like his father, the former philosopher-president of Czechoslovakia, Jan Masaryk was a great European, and his death is a loss to the whole world as well as a very serious blow to Czechoslovakia at a critical time in her tragic history.

Prague is shortly to celebrate the sexcentenary of the founding of its famous university, and though Masaryk had no direct connexion with that institution his death cannot fail to cast a cloud over the ceremonies planned for this historic occasion. Unfortunately, too, recent events in Czechoslovakia have given rise to anxiety in Britain and elsewhere concerning the position and fate of several colleagues well known for their researches and other contributions to the advancement of knowledge. It is understood that some, including the rector of the Charles University, Dr. Karel Engliš, have been dismissed. Science and learning suffered heavily enough during the Nazi occupation through the closure of the universities and the execution of many members of their staffs, and to-day Czechoslovakia cannot afford to lose a single talented teacher or scientific worker. Masaryk certainly realized this. His attitude towards his fellows was one of encouragement and tolerance. It found expression, for example, when he was filling up an American immigration form and came to the question, "What Race?" His answer was, "I belong to the human race".

Prof. Bohumil Němec

PROF. BOHUMIL NĚMEC, the well-known botanist, celebrated his seventy-fifth anniversary in Prague on March 12, and we are glad to report that he was then in good health. He is at present engaged upon a comprehensive text-book of general botany in Slovak for use by students at Bratislava University and for upper forms in the Slovak high schools, and a history of botany which will have a wider appeal. Němec's first researches, on diplopods, appeared in the *Transactions of the Royal Bohemian Scientific Society* in 1895, and since then he has published many researches in plant physiology in Czech, English and other journals. Only recently he exhibited to scientific audiences in England and France specimens of gold that had been extracted from ashes of plants obtained from Slovakia. He has been interested in the occurrence in plants of unusual elements for many years. Němec is not only a great experimentalist and investigator but also an able lecturer, and many of his students have contributed to the advancement of pure and applied botany. Practically all Czechoslovakia's scientific forestry and agricultural experts studied under him at the Botanical Institute of the Charles University of Prague, which he directed for so many years. Since 1945 he has been occupied at the University of Bratislava in lecturing to Slovak students, and has advised on, and supervised, the establishment of botanical and physiological institutes in that University, which dates only from 1919.

Botany at Bedford College, London: Prof. L. J. Audus

DR. L. J. AUDUS, who has just been appointed to the Hildred Carlile chair of botany at Bedford College, London, is a distinguished member of the younger school of plant physiologists. He received his physiological training at Cambridge under the late Dr. F. F. Blackman, whose admirable tuition matured so many brilliant pupils. From Cambridge he went to University College, Cardiff, where he was lecturer in botany until he joined the Royal Air Force in 1941. He was stationed at Singapore, and when that city fell he escaped to Java, but was there captured by the Japanese. For three and a half years he was a prisoner in Java and Amboina, undergoing many hardships. During this period he collaborated with Dutch men of science who were fellow prisoners to organise an extremely resourceful manufacture of yeast-food, on a scale sufficient to keep vitamin starvation at bay and thus prevent what would otherwise have been a terrible mortality from beriberi. Dr. Audus is no mean artist and the sketches he was able to bring home illustrate life in Japanese prison camps with dramatic clarity. On his return to Britain he was appointed to the Soil Metabolism Unit of the Agricultural Research Council, then situated at University College, Cardiff, under Dr. J. H. Quastel, and he was engaged in research on the action of growth-promoting substances in the soil. The Unit was closed at the end of 1947 with the departure of Dr. Quastel to Canada, and Dr. Audus had just been appointed as Monsanto lecturer in plant physiology at Cardiff when the opportunity of the appointment at Bedford College called him away. He goes accompanied by the regrets and best wishes of all his colleagues at Cardiff.

Max Planck Society for the Advancement of Scientific Research

THE Max Planck Society for the Advancement of Scientific Research was formed on February 26, with the approval of the Military Governments of the British and U.S. Zones of Germany. It will replace the Kaiser Wilhelm Society for the Advancement of Science which was dissolved in July 1946. The fact that the latter society had during the War come under the influences of the Nazi regime was one of the reasons for the order being given for its dissolution. The new Society, which will operate under the provisions of the Allied Control Council's law No. 25, relating to the control of scientific research, will have as its main object the encouragement of fundamental and independent research on peaceful lines. It will make it possible once more for the British and American Zones of Germany to be fully represented in the international field of scientific research. Otto Hahn, known for his fundamental research in nuclear fission, has been elected president, and Dr. Ernst Telschow, of Göttingen, who, since the end of the War, has played a leading part in maintaining scientific work in the U.S.–British

Zones, has been appointed general director. The following have been elected members of council: Prof. Edrich Retener, director of the Institute of Physics, Technical High School, Stuttgart; Prof. Adolf Windaus, formerly director of the Chemistry Institute, University of Göttingen; Dr. Wilhelm Boetzkef, Banking Boetzkef, banking director, of Düsseldorf; Prof. Georg Schrieber, professor of theology, University of Münster; Dr. Theo Goldschmidt, director of the chemical manufacturing firm in Essen bearing his name; Adolf Grimme, Minister for Education, Land Niedersachsen; Prof. Richard Kuhn, director of the Kaiser Wilhelm Institute for Medical Research, Heidelberg; Dr. Alfred Petersen, president of the Frankfurt Chamber of Commerce and Industry; Senator Landahl of Hamburg; and Prof. Heinrich Weiland, formerly director of the Institute of Chemistry, University of Munich. Prof. Hahn, Dr. Telschow and Prof. Max von Laue are *ex officio* members of council. In addition to the president and the general director, the following will constitute the administrative council: Prof. Retener (vice-president); Prof. von Laue (general secretary); Prof. Kuhn (deputy general secretary); Dr. Boetzkef (treasurer); and Dr. Petersen (deputy treasurer).

Serological Museum of Rutgers University

THERE has been established at Rutgers University, in New Jersey, a museum for the collection, preservation and study of the proteins of the blood and other tissues of the bodies of organisms, in the belief that such proteins are as characteristic as other constituents and are as worthy of preservation and comparison as skins and skeletons. The establishment of the Serological Museum is a logical consequence of the studies in systematic serology which have been conducted at Rutgers University since 1925, by Dr. Alan Boyden and his students and colleagues. Dr. Boyden has himself collected many representative samples of the blood sera of animals from laboratories in the United States and Great Britain, and others have been contributed by institutions and individuals; in recent years lyophilized (frozen and dried) samples of animal sera or of the purified fractions of such sera have been contributed by industrial laboratories. The principal objectives of the Serological Museum will be to preserve representative sera or other proteins of organisms and to study the means of improving methods of preservation; to build up a collection of sera and other proteins of as many kinds of organisms as possible; to share the samples collected with competent workers; and to study the methods used in systematic serology. Although the sera of hundreds of species of animals have already been collected, no group of animals is as yet adequately represented in the collection. The sera of many kinds of animals—vertebrate and invertebrate—are still needed. The growth of this Museum and its capacity for service will depend largely on co-operative efforts by many individuals and institutions. Those interested in the subject are invited to correspond with Dr. Alan Boyden, Rutgers University, New Brunswick, New Jersey, U.S.A.

Climatic and Ecological Changes in Northern Waters

AT the meeting of the North-Western Area Committee of the Conseil Permanent International pour l'Exploration de la Mer on October 22, 1947, the possible influence of the present climatic changes on the lives of marine animals (density, distribution, reproduction, migration, etc.) was discussed. Having regard to the probable importance of these changes in fisheries investigations, it was decided that every opportunity should be taken, by fishery research vessels and other suitable ships, to obtain without delay all possible data bearing upon this problem, especially in waters north of the Faroes, north and east of Iceland and in the Denmark and Davis Straits. It was also decided that relevant information from sources other than those of fisheries research would be of great value and should also be obtained. The information required comprises hydrographical, meteorological, glaciological and associated changes in northern regions, and the influence of those changes on the habits and distribution of animals and plants, both terrestrial and marine. Records should include locality (latitude and longitude), depth (if marine records), date, name and profession of observer, and references to relevant publications. Especially important are new records of animals and plants from localities recently included within their range of distribution, or the absence of species from previously populated areas. All data should be given exhaustively but concisely, and arranged so far as possible under the following headings: (1) meteorology; (2) hydrography; (3) glaciology; (4) animals; (*a*) Mammalia, (*b*) Aves, (*c*) Testudinata (especially observations on the west coasts of the British Isles), (*d*) Pisces, (*e*) Invertebrata; (5) plants; (6) other items. Contributions to this inquiry are earnestly requested from everyone in possession of useful information, and should be addressed to Dr. Å. Vedel Tåning, Charlottenlund Slot, Charlottenlund, Denmark, preferably during December of each year.

Science and Religion

FOR two hundred years, popular writers have attacked traditional religious beliefs in the name of science and pretty well undermined the faith of the plain man. Now, however, the sceptical attitude is turned against science itself, at a moment when, thanks to recent developments of physical theory, science appears vulnerable intellectually and, thanks to recent developments of military and political technique, still more vulnerable morally. Modern men, finding themselves with nothing to put their faith in, fill the spiritual vacuum with bogus religion based on bogus science, like Nazism and Communism. Even the more modest alternative, the assurance that all problems are technological and that the salvation of mankind depends on bigger and better gadgets, is not entirely satisfactory. The new quarterly magazine, *Science and Religion* (edited by Dr. Robert E. D. Clark, Paternoster Press, Ludgate House, Fleet Street, London, E.C.4. 1*s.* 6*d.* per copy), is intended, as the editor says, "to make science cultural; to show how science may strengthen religious belief instead of being allowed to develop independently and unconnected with our deepest needs". It is intended for the general public and particularly the young who learn something about science at school and are eager to know more. The articles in the first two numbers are excellently designed for their purpose. They are short, simply written and informative. Many of them are reviews of recent important books. The subjects include chemistry, biology, anthropology, psychology on the more purely scientific side, also historical and philosophical work. If the present standard can be maintained, the venture deserves to be a success.

Incentives in Industry

THE perennial problem of incentives in industry has recently been considered by Prof. C. H. Mace (*Occupational Psych.*, **22**, No. 1; January 1948). After agreeing with a recent statement of Nigel Balchin's that the main satisfaction in work will come from making it as enticing as possible, Mace then suggests that an alternative satisfaction will come from making work obligatory, although, as he repeatedly states, all work is complexly motivated. The appeal to obligation is based on the belief that there are, in human nature, forces that impel a man to perform tasks that he finds unpleasant and which he is under no compulsion to perform. In times of crisis the 'emergency response' of the emotions will produce effects but only by a draft on reserves, and Mace suggests that to maintain the will to work at an optimum level will depend upon long-term sources of human motivation. In the professions and the skilled crafts a dominating motive which compels people to stick to their jobs is because they must. They depend upon something being expected of them and upon the sustaining influence of someone's valuation. In jobs which contain little of inherent interest Mace indicates that there should be a more effective use of social pressures by placing responsibility not exclusively on the individual but on the working groups; that is, instead of controlling human energies from above or from within, control should be from around. Scientific study of these problems would afford a new approach to the problem of incentives.

Potato Blight and the Weather in Britain

IT would be of considerable advantage if initial outbreaks of potato blight could be forecast with accuracy. This would allow timely application of protective sprays, the value of which is directly proportional to the earliness of effective application. Van Everdingen in Holland has suggested conditions which would herald the first attack by blight, and A. Beaumont has investigated their application to Devon and South Cornwall (*Trans. Brit. Mycol. Soc.*, **31**, Parts 1 and 2; July 1947). The Dutch rules indicated blight in south-west England rather earlier than it appeared, and it has been found that revised conditions gave more accurate forecasts. The conditions are: (1) minimum temperature not less than 50° F., and (2) relative humidity more than 75 per cent for two consecutive days. Mr. Beaumont's suggestions have been available in summary form for some time, and have been tried in other areas. They have given useful forecasts; but in some northern areas of Britain it seems necessary to neglect the earliest forecasts of the season, presumably because blight spores may not be present.

British Museum (Natural History)

A SERIES of exhibits illustrating the "Succession of Life through Geological Time", from the origin of life perhaps a thousand million years ago to the emergence of man within the last million years, has just been opened to the public in one of the geological galleries of the British Museum (Natural History). Each geological period is represented by a small selection of the fossil remains of plants and animals which lived in those times, showing how fossils reflect past conditions, and how the various forms of life developed and reacted on one another in slowly changing environments. The great amount of war damage still to be repaired will make it impossible to open all the geological galleries to the public for some time to come; and in the meantime this new series of exhibits will serve as a general introduction to the study of fossils.

Photocopies of French Scientific Periodicals

IT has already been announced that a small French scientific library had been opened at the Institut Français du Royaume-Uni, and arrangements made to obtain on loan microfilms of articles from periodicals not available in the library (see *Nature*, November 15, 1947, p. 669). Since many requests have been received for photocopies in preference to microfilms, the Cultural Counsellor to the French Embassy, with the help of the British Exchange Control, has now arranged a scheme for obtaining microfilm enlargements from France against payment in sterling. Charges will vary according to the size of the enlargement, but for the average periodical page-size (18 cm. × 24 cm.) will be about 1*s.* 4*d.* a page, plus a small charge for postage. All requests for photocopies should be addressed, not to the Institut Français, but to the General Secretary, French Scientific Office, 58 Knightsbridge, London, S.W.1, from whom further details can be obtained.

Frank B. Jewett Fellowships: Awards for 1948–49

THE American Telephone and Telegraph Company has awarded Frank B. Jewett fellowships for 1948–49 for research in the physical sciences to the following: Dr. Warren J. Brehm, at present investigating the possible synthesis of lysergic acid at Harvard University; Dr. Ernest M. Grunwald, for the study of the activity of non-electrolytes in certain solvents; Dr. Leon A. Henkin, instructor in mathematics at Princeton University, for research in the application of mathematical logic to the sciences; James A. Jenkins, for research related to topological mapping problems; Robert Karplus, for work on nuclear research at the Institute for Advanced Studies, Princeton; Alvin I. Kosak, research fellow in the chemistry department, Ohio State University, for research in organic chemistry at Harvard University; Dr. Joaquin M. Luttinger, for work on the theory of the superconductive state; Dr. Paul Olum, who received a Frank B. Jewett fellowship for 1947–48, to continue his work in algebraic topology; Richard N. Thomas, for the study of superthermic phenomena in stellar atmospheres.

British Commonwealth Entomological Conference

THE Fifth Commonwealth Entomological Conference is to be held in London during July 22–30. There will be several open meetings at which the following subjects will be discussed: (1) insecticides, including recent developments, mode of action, uses and limitations in the field, mechanical appliances, and application from the air; (2) biological control of insects and weeds; (3) estimation of insect populations in the field; (4) recent developments in the control of insects in stored products; (5) tsetse research; (6) Continental quarantine; (7) locusts and grasshoppers. Programmes will be available in due course on application to the Director, Commonwealth Institute of Entomology, 41 Queen's Gate, London, S.W.7.

Congress of Genetics

A CONGRESS of Genetics is to be held at the Centro di Genetica (Istituto Lazzaro Spallanzani), Pavia, during April 2–4. The first two days of the Congress

will be devoted to discussions on work carried out at the Centre on cytogenetics and physicopathology respectively; discussions will also be held on general biological problems such as the relationships between embryology and genetics, genetics and chemical biology, physicopathology and genetics and genetics and systematics. The third day will be devoted to a study of genetics in relation to entomology; it is hoped that entomologists will take part in this Congress as well as geneticists and general biologists. Accommodation will be available at the halls of residence of the University of Pavia. Particulars of the Congress can be obtained from Prof. Carlo Jucci, Centro di Genetica (Istituto Lazzaro Spallanzani), Pavia.

Physical Society: Annual Summer Meeting

THE annual summer meeting of the Physical Society will be held in Oxford during July 23–24. The main subject will be "Microwave Spectroscopy", including nuclear resonance. In addition, time will be reserved for a discussion on "Helium 3" and other items of topical interest. The Clarendon Laboratory will be open to visitors throughout July 24. Among the speakers will be Dr. B. Bleaney (Oxford), Dr. N. Bloembergen (Leyden), Dr. R. M. Bozorth (Bell Telephone Laboratories), Prof. J. G. Daunt (Ohio State University), Prof. C. J. Gorter (Leyden), Dr. J. H. E. Griffiths (Oxford), Prof. A. G. Hill (Massachusetts Institute of Technology), Dr. C. Kittel (Bell Telephone Laboratories), Prof. R. V. Pound (Harvard), Prof. M. H. L. Pryce (Oxford), Dr. B. V. Rollin (Oxford), Prof. J. C. Slater (Massachusetts Institute of Technology), Prof. J. H. Van Vleck (Harvard). Those wishing to contribute to the Conference discussion should communicate with Prof. F. E. Simon at the Clarendon Laboratory, Oxford. Non-members of the Physical Society wishing to attend should write for further information before April 1 to the Secretary/Editor, Physical Society, 1 Lowther Gardens, Prince Consort Road, London, S.W.7.

Congress of Universities of the British Empire

THE annual Congress of Universities of the British Empire will be held at Oxford during July 19–23, and a provisional programme has been issued. The topics for discussion include relationship of the State and the universities; inter-university relations; the balance of research and teaching at universities; structural and moral changes produced in modern society by scientific and technological advance; general plans for Colonial higher education; and the extension of the University Secondment Scheme. Further particulars can be obtained from the Secretary, Universities Bureau of the British Empire, 8 Park Street, London, W.1.

University of London: Appointments

THE following appointments in the University of London have been announced: Mr. K. de B. Codrington, keeper in the Indian Section of the Victoria and Albert Museum since 1935, to the University chair of Indian archæology tenable at the Institute of Archæology and at the School of Oriental and African Studies; Prof. E. D. Hughes, professor of chemistry at the University College of North Wales, Bangor, to the University chair of chemistry tenable at University College as from October 1; Mr. Gordon Manley, University lecturer in geography at Cambridge, to the University chair of geography tenable at Bedford College as from October 1.

Special Librarianship

A STUDY Group on Special Librarianship is being arranged by the Association of Special Libraries and Information Bureaux and will be held at the Library Association, Chaucer House, Malet Place, W.C.1, during April 13–17. The general theme will be "The Compilation of Information in Special Libraries", and the course is designed to help students who have recently started work in such libraries. The programme includes visits to special libraries in London, and lectures by Mr. B. Fullman, information officer of the British Non-Ferrous Metals Research Association; Mr. H. S. Hyland, of the House of Commons Library; Miss A. M. Goodwin, Economic Information Unit of the Treasury; and Dr. W. E. Batten, of I.C.I., Ltd., Plastics Division. Further particulars can be obtained from the Association of Special Libraries and Information Bureaux, 52 Bloomsbury Street, London, W.C.1.

Announcements

THE Geographic Society of Sweden has awarded its Vega Medal to Admiral Richard Byrd. This Medal, named after the Swedish *Vega* expedition which, with the Swedish explorer Adolf Erik Nordenskjöld as leader, was the first to sail through the North-East Passage in 1878–80, is awarded annually in recognition of prominent achievements in the field of exploration.

THE Manchester and District Branch of the Institute of Physics is arranging a conference, to be held in the Physics Department of the University of Manchester during July 8–10, on "Semiconductors and their Applications". Communications regarding the conference should be sent to Dr. F. A. Vick, Physics Department, University, Manchester 13.

A CONFERENCE is being arranged by the Northern Branch of the Association of Special Libraries and Information Bureaux in Leeds during April 2–3. Dr. E. Semister, director of research, Kirkstall Forge, Ltd., will address the opening session on "Research and Information Services for the Metallurgical Engineer and the City Librarian", and Mr. F. C. B. Hutchings will speak on "Training and Practice in Special Librarianship" at the following session; there will be a civic reception in the evening. The morning session on April 3 will be addressed by Mr. Hugh Gaitskell, Minister of Fuel and Power. Visits to the Wool Industries Research Association and the Central Research Department of Brotherton and Co., or to Temple Newsam, complete the programme.

THE Ministry of Agriculture and Fisheries invites applications for ten senior scholarships, tenable at university departments of agriculture, or agricultural colleges, for degree or diploma courses in an agricultural subject, or at veterinary colleges for courses in veterinary science; six extended junior scholarships (for those who have already held junior awards), and sixty junior scholarships, tenable at farm institutes or similar institutions, for courses not exceeding one year in duration, in agriculture, horticulture, dairying or poultry husbandry. The scholarships are open to the sons and daughters of agricultural workers and to *bona fide* workers in agriculture. Forms of application, to be returned by April 30, can be obtained from the Secretary of the Ministry, Block 4, Bickenhall Mansions, Baker Street, London, W.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

A Revised Sargent Diagram

In 1938 Dr. Bretscher and I[1] published a Sargent diagram for the 'natural' β-active bodies in a form in which the degree of uncertainty arising from the incomplete state of knowledge at the time was clearly exhibited, and certain 'unobserved' transitions were also represented as in an earlier diagram of Gamow and Teller[2].

Since our first diagram was published, much work has been done on the β-particle spectra of the classical radioelements and many of the previous uncertainties have been resolved; also a great deal of information concerning 'artificially produced' heavy species has accumulated in the interim[3]. Furthermore, various attempts have been made to construct Sargent diagrams covering the whole range of known β-active bodies, both 'heavy' and 'light'[4].

The present note is concerned with the restricted topic of the diagram appropriate to the range of Z (atomic number) from 81 to 93, inclusive: this diagram, containing the newly available information and with outstanding uncertainties represented as before, is given in the accompanying figure. 'Points' are plotted for fifty β-transitions, forty-one 'observed' and nine 'unobserved'. No detailed information is available for possible β-active species with $Z = 86$, 85 or 84, thus the points belong to two groups in Z: twenty-three are for $93 \geqslant Z \geqslant 87$ and twenty-seven for the narrower group having $83 \geqslant Z \geqslant 81$. Of the unobserved transitions, five belong to the group of lower, and four to the group of higher, Z. Points for species with A (mass number) odd are represented by open uncertainty loops; those for species with A even by full loops in the diagram.

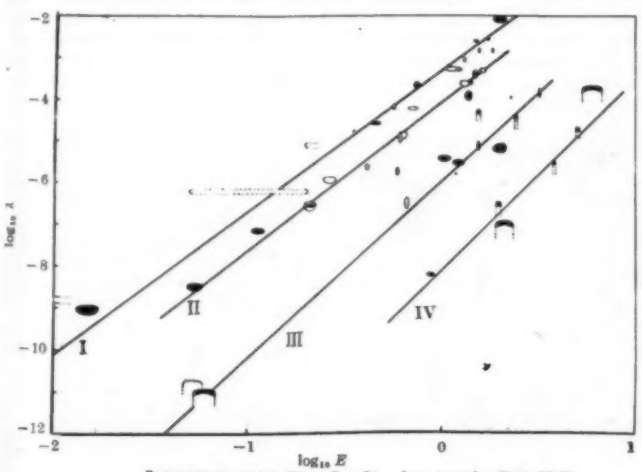
Traditionally, two well-defined 'lines' have been recognized on a diagram such as we are discussing, and evidence for lines of higher order has been deduced from the unobserved transitions[3]. Moreover, in recent discussions it has generally been assumed that the well-defined lines correspond to disintegration transitions which are 'allowed' or 'once-forbidden' according to the selection rules of Gamow and Teller[2]. These lines are the lines labelled I and III in the present diagram. A significant fact emerges, however, in that the revised diagram shows quite clearly the presence of another line (II), intermediate between the two lines already recognized, and nearer to the allowed (I) than to the original once-forbidden (III) line. The interpretation of this new line is a matter of interest.

In the first place the suggestion was examined that a doubling of the allowed line was involved, corresponding to the two Z groups of the diagram. This suggestion was rejected after an analysis of the distribution of points on the lines: of the 'points' overlapping line I, four belong to the higher Z group and three to the lower; for line II the corresponding ratio is 4 to 5. Also the separation of the lines ($\Delta \log_{10}\lambda$, 0·75–1·1) is markedly greater than the separation calculated on the Fermi theory for the extreme values of Z in question. This calculated separation (Z, 93–81) is practically constant ($\Delta \log_{10}\lambda$, 0·3) over the whole energy-range from 0·3 to 3 MeV.

It was therefore assumed, tentatively at least, that a revision of the assignment of orders of forbiddenness was required, the new line (II) representing once-forbidden and line III twice-forbidden transitions according to the Gamow–Teller rules. This revision brings certain definite advantages. Here it will be sufficient to mention the β-disintegration of radium E, which now becomes twice-forbidden. Hitherto, it has been difficult to explain the form of the energy spectrum in this case on the assumption that the transition is once-forbidden only[5]. Other cases will be discussed in greater detail in due course[6].

While the reassignment of order, above described, is definitely put forward as the most probable interpretation of the revised diagram, one further possibility should be mentioned. Itoh[4] has directed attention to a feature of the Sargent diagram for the lightest of the artificially radioactive species (positron- and electron-active) which in its empirical aspect is entirely similar to the feature discussed here. He distinguishes four lines on this diagram at the following intervals of $\log_{10}\lambda$, namely, $\Delta \log_{10}\lambda \sim$ 1·5, 2·4, 2·5, respectively. It might appear tempting to identify this structure with the structure of the diagram given in this note. But Itoh gives reasons for supposing that his first line represents 'super-allowed transitions' in respect of the Gamow–Teller classification—or, in the sense of the Wigner[7] theory of the symmetry properties of nuclear states, the only 'truly allowed' transitions, those involving initial and final states belonging to the same symmetry multiplet. Such transitions, according to this theory, would not be expected except when the change in isotopic number in the transition is (1) ↔ (−1), or in certain cases (2) ↔ (0), and this condition limits present knowledge of transitions of this type to the mass range $A < 43$.

A final point might be made in this preliminary discussion. It is that there is a very noticeable concentration of the points for A odd on the Sargent lines I



SARGENT DIAGRAM, $80 < Z < 94$. λ IN SEC.$^{-1}$; E IN MEV.

and II. Out of eighteen points for A odd, only two fall significantly below line II, whereas there are eighteen points for A even below this line. Similarly, all the points on or below line IV (five 'unobserved' points and the representative point for the 3·5yr. $^{204}_{81}$Tl) are for A even (and Z odd). It would appear that very frequently there is a large difference of spin between the ground-states of initial and final nuclei in these latter cases. This conclusion is not surprising when it is realized that the neutron and proton numbers change from the $\binom{\text{odd}}{\text{odd}}$ to the $\binom{\text{even}}{\text{even}}$ configuration in such transitions.

N. FEATHER

Department of Natural Philosophy,
University of Edinburgh.
Dec. 18.

[1] *Proc. Roy. Soc.*, A, **165**, 530 (1938).
[2] *Phys. Rev.*, **49**, 895 (1936).
[3] See, for example, Fajans and Voigt, *Phys. Rev.*, **60**, 619 (1941). Maurer and Ramm, *Z. Phys.*, **119**, 602 (1942). Hagemann *et al.*, *Phys. Rev.*, **72**, 252 (1947). English *et al.*, *Phys. Rev.*, **72**, 253 (1947).
[4] See, for example, Kojima, *Proc. Phys. Math. Soc. Japan*, **22**, 384 (1940). Itoh, *ibid.*, 531.
[5] Konopinski, *Rev. Mod. Phys.*, **15**, 209 (1943).
[6] "Nuclear Selection Rules" (Camb. Univ. Press, in preparation). Feather and Richardson (in course of publication).
[7] *Phys. Rev.*, **56**, 519 (1939).

Electron Tracks in Photographic Emulsions

PHOTOGRAPHIC emulsions have been used to an increasing extent for the recording of nuclear tracks passing through the sensitive layer, in particular by Dr. C. F. Powell and his collaborators[1], and by Demers[2]. Particles of relatively high ionizing power such as alpha-particles and protons give well-defined tracks; those of lesser ionizing power, such as mesons, yield rather tenuous tracks; while electrons do not as a rule produce recognizable tracks in the emulsions available so far, although Demers[2] claims to have seen electron tracks on one of his emulsions.

A new emulsion has recently been evolved in the Kodak Research Laboratories which is sufficiently sensitive to enable electron tracks to be recorded unmistakably.

The emulsion was tested for proton sensitivity by bombardment with neutrons from a radium–beryllium source, with a 17-cm. thickness of lead interposed between the plates and the source to diminish the gamma-ray intensity incident on the sensitive material. Microscopical examination of the plates after processing showed that the background to the proton tracks was of a much more heterogeneous nature than was obtained with exposures to a pure alpha-ray emitter, for example, polonium.

Under high magnification, this heterogeneous background was seen to consist of numerous fairly short, highly curved chains of developed grains. It is believed that these are the low-energy ends of tracks due to photo-electrons and recoil electrons liberated by gamma-rays. Electrons, being particles of low mass and low ionizing power, might be expected to produce just such types of tracks in a photographic emulsion, which remind one strongly of similar tracks obtained in a cloud chamber.

Since they are highly curved, very few of these tracks are in one plane, and satisfactory photomicrographs are therefore difficult to obtain. Figs. 1 and 2 are photomicrographs (× 2,000) showing the type of track obtained. Fig. 3 is a photomicrograph at the same magnification of a plate exposed to light to give approximately the same average grain density as the gamma-ray exposure.

I should like to acknowledge the co-operation of Mr. D. H. Perkins of the Imperial College of Science and Technology, London, and my colleagues in this Laboratory in the evolution of this emulsion.

R. W. BERRIMAN

Research Laboratory, Kodak, Ltd.,
Wealdstone,
Middlesex.
Dec. 3.

[1] Powell, Occhialini, Livesey and Chilton, *J. Sci. Instr.*, **23**, 102 (1946).
[2] Demers, *Can. J. Res.*, **25**, 223 (1947).

Resolution Testing in Autoradiography

THE resolution obtainable in autoradiographs has so far been estimated[1] by the sharpness obtainable when photographic emulsions are exposed in contact with biological sections in which radioactive isotopes have been deposited by biochemical processes. The distribution of the radioactive isotope will, however, vary from one specimen to another, and T. C. Evans[2] points out that even successive sections from the same specimen will not be absolutely identical. Strict comparisons of the resolution given by different techniques or photographic emulsions are thus most difficult to make.

Preliminary tests showed that a photographic silver image on a material such as the Kodak Maximum Resolution plate could be converted successively to silver bromide and silver iodide and still give a line separation of 0·5 μ. These reactions can therefore be used to give a deposit of I^{121} with any required

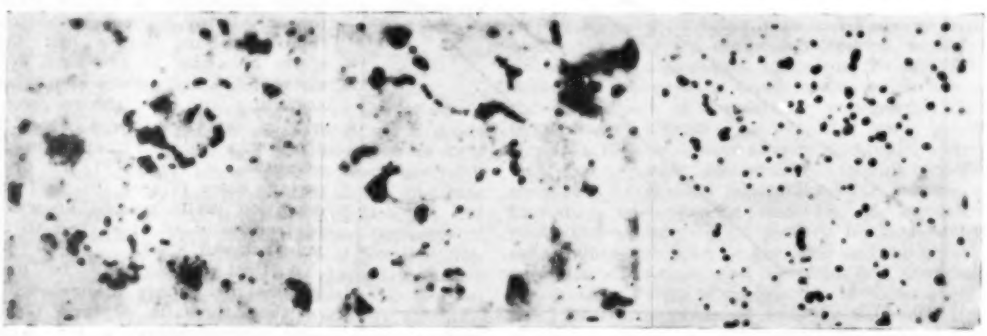


Fig. 1 Fig. 2 Fig. 3

distribution, thus forming a radioactive test chart. Such test charts were made by applying about 0·01 c.c. of a solution of I^{131} (supplied by the Medical Research Council) to an area 2 mm. × 2 mm. of the emulsion surface containing a resolution test image which had previously been converted to silver bromide. Fig. 1 shows a photomicrograph of some of the units of the original test chart image, the units from *A* to *F* representing line separations of respectively 4·5 μ, 3·7 μ, 3·0 μ, 2·5 μ, 2·0 μ and 1·7 μ. After washing and drying, a 4-μ thick coating of a highly concentrated fine-grain emulsion, prepared in these laboratories for the recording of nuclear tracks[2], was transferred to the surface of the test chart, as described by S. R. Pelc[1]. After the 'exposure', the emulsion-coated test chart was soaked in water for a few minutes, and the emulsion layer was processed in the stripped condition. Fig. 2 shows the autoradiograph images corresponding to Fig. 1. In the original autoradiograph it is apparent that useful resolution is obtained with 2·5 μ (*D*) and perhaps even with 2·0 μ (*E*) separation, but not with 1·7 μ (*F*).

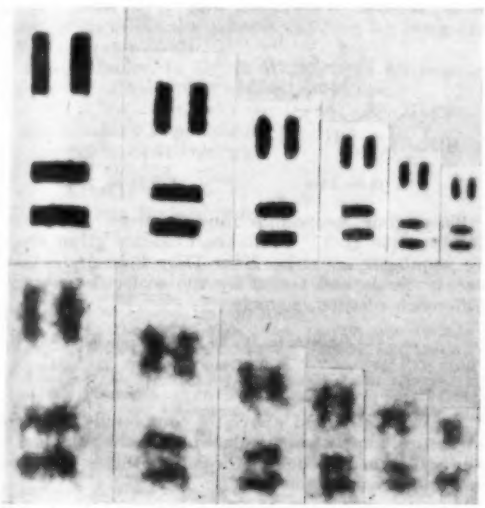


Fig. 1 (above). PHOTOMICROGRAPH (× 700) OF IMAGE FROM ORIGINAL TEST CARD

Fig. 2. IMAGES OF AUTORADIOGRAPH (× 700) CORRESPONDING TO FIG. 1

It would seem that such test charts could be employed for systematically estimating the relative importance of the various emulsion and geometrical factors influencing the resolution of autoradiographs. They might also be used for comparing the effect of electrons of varying energy given by different isotopes. Another possibility is the production of test charts made from microphotographic replicas of tissue sections to aid in the interpretation of autoradiographs made from biological material.

G. W. W. STEVENS

Research Laboratory,
Kodak, Ltd.,
Wealdstone,
Middlesex.
Nov. 21.

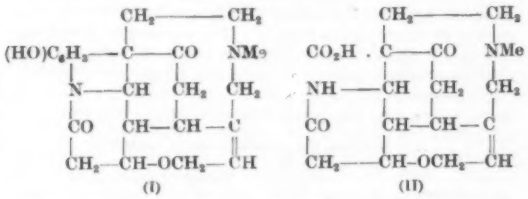
[1] Pelc, S. R., *Nature* [160, 749 (1947)].
[2] Evans, T. C., *Radiology*, 49, 206 (1947).
[3] Berriman, R. W., *Nature* [preceding letter].

Relation of Vomicine to Strychnine and Brucine

VOMICINE, $C_{22}H_{24}O_4N_2$, a congener of strychnine, $C_{21}H_{22}O_2N_2$, has been investigated by Wieland and his collaborators; but no precise connexion between the alkaloids has yet been disclosed, though many reactions and transformations suggest the close similarity of their molecular structure. On oxidation with chromic acid[1], vomicine yields an acid, $C_{17}H_{22}O_5N_2$, $3H_2O$, which characteristically loses carbon dioxide at 130°, affording a base, $C_{16}H_{22}O_3N_2$. We have now found that the same acid can be obtained by oxidation of N-methyl-*sec*-pseudostrychnine, or better, N-methyl-*sec*-pseudobrucine, by means of chromic acid. The identity has not yet been confirmed by direct comparison[2]; but there can be little doubt of it from the analyses ($3H_2O$), rotatory power, melting points, and behaviour on heating. The resulting base has the composition, melting point and crystalline form recorded for the product from vomicine.

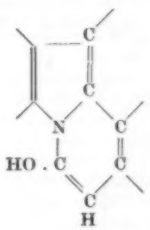
This result establishes that vomicine is to an *ar*-hydroxystrychnine as N-methyl-*sec*-pseudostrychnine is to strychnine. The probability of this outcome was suggested in a letter from one of us to Prof. Wieland in 1939, and the theory has been mentioned on several occasions since that time. The proof of it which is now available enables us to make use of other aspects of vomicine chemistry, which become directly applicable to the strychnine problem.

Thus the ready formation of the base, $C_{16}H_{22}O_3N_2$, already mentioned, is a clear indication of the site of a carbonyl group in N-methyl-*sec*-pseudostrychnine, and affords strong support to the formulæ advanced on other grounds. In illustration, (I) and (II) represent vomicine and the acid $C_{17}H_{22}O_5N_2$, respectively; (II) is seen to be a β-keto-acid, probably stabilized as $CO_2^- - \ddot{C} - \dot{C}(OH) - \dot{N}Me^+$.



The formation of such a betaine is doubtless facilitated by the cyclization which it implies, and explains why (II) is capable of existence under the conditions of its manipulation.

R. B. Woodward and his collaborators[3] have recently suggested, on the basis of ultra-violet spectra, that Leuchs' 'strychnone' obtained by the action of hydrogen peroxide on pseudostrychnine is a true indole derivative. We have reached the same conclusion by a study of the brucones[3]. These have the composition of oxobrucines; the isomeride, m.p. 310°, is a by-product in the preparation of pseudo-brucine; that of m.p. 180° is obtained by action of hydrogen peroxide on pseudobrucine. The former shows normal brucine reactions and probably contains : N(*b*).CO—C=CH—, but the latter (m.p. 180°) exhibits



a unique series of colour reactions and is probably an aromatic indole. It is the only brucine derivative we have encountered which does not give a related cacotheline on treatment with nitric acid. The product, described by Leuchs *et al.*[3] as such, is actually a simple nitro-derivative which has also suffered hydrolysis of : N . CO —, probably : N(*a*) . CO . , to : NH CO_2H . .

The intense green fluorescence and yellow-coloured solutions often obtained from strychnine derivatives (and easily from the above brucone) by the action of alcoholic alkalis is attributed to the formation of the structure (III).

A. S. Bailey
R. Robinson

Dyson Perrins Laboratory, University,
Oxford. Jan. 16.

* *Added March* 13. Thanks to the courtesy of Prof. H. Wieland, the direct comparison of the base $C_{16}H_{28}O_2N_2$ from brucine and vomicine has now confirmed the identity.

[1] Wieland, *Annalen*, **460**, 193 (1929); **481**, 133 (1931).
[2] Nelson, Brehm and Woodward, *J. Amer. Chem. Soc.*, **69**, 2250 (1947).
[3] Leuchs, Tuschen and Mengelberg, *Ber.*, **77**, 403 (1944).

The *C/D* Ring Union in Œstrone and Equilenin

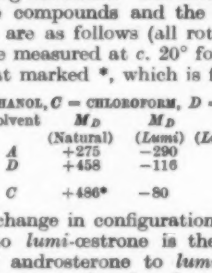
The method of molecular rotation differences which has been applied to other steroid structural problems by Barton[1] throws some light on the nature of the *C/D* ring union in œstrone and equilenin recently discussed by Shoppee[2,3] and by Heer and Miescher[4,5]. The evidence thus obtained, which is given below, when combined with that collected by Shoppee[2], indicates that (+)-equilenin and probably (+)-œstrone have the same configuration at the *C/D* ring union as the androgens, bile acids and sterols. The data available are few, and the conclusions are therefore drawn with reserve.

Configuration at C_{13}. Butenandt and co-workers[6,7] obtained by irradiation of (+)-œstrone and androsterone *lumi*-compounds, which are epimeric at C_{13} with the starting materials. The molecular rotations (M_D) of these compounds and the differences (Δ) between them are as follows (all rotations given in this letter were measured at *c.* 20° for the sodium *D* line except that marked *, which is for 5461 A.):

A = ethanol, *C* = chloroform, *D* = dioxan

	Solvent	M_D (Natural)	M_D (*Lumi*)	Δ (*Lumi*—natural)	Refs.
Androsterone	*A*	+275	−290	−565	7,8
Œstrone	*D*	+458	−116	−574	6,9
Œstrone methyl ether	*C*	+486*	−80	−566	6,10

Clearly the change in configuration from 'natural' (+)-œstrone to *lumi*-œstrone is the same as that from 'natural' androsterone to *lumi*-androsterone; 'natural' (+)-œstrone therefore has the same configuration at C_{13} as 'natural' androsterone [I] and all the other 'normal' steroids which are related to it. The work cited by Shoppee[2] shows conclusively that (+)-œstrone and (+)-equilenin have the same configuration at C_{13}; (+)-equilenin is therefore a 13-*n* compound.



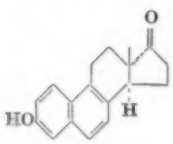
I

Configuration at C_{14}. Recent work by Plattner, Ruzicka, Heusser, Pataki and Meier[11] on 14-*iso* compounds permits the calculation of $\Delta_{14} = M_D(14\text{-}iso) - M_D(14\text{-}n)$.

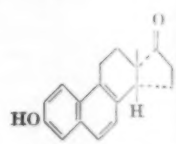
	Solvent	M_D (14-*n*)	M_D (14-*iso*)	Δ_{14}	Refs.
17-*iso*-*allo*-ætiocholanic acid methyl ester	*D*	−130	+83	+213	11,12
3(*β*)-acetoxy-17-*iso*-ætiocholanic acid methyl ester	*C*	−105	+109	+214	11,13

The molecular rotations of the four equilenins (in dioxan) are as follow[14]:

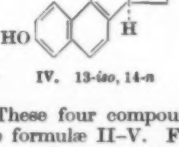
(+)-*iso*-equilenin	+391	(−)-*iso*-equilenin	−391
(+)-equilenin	+224	(−)-equilenin	−224



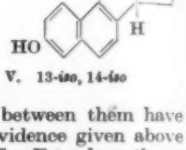
II. 13-*n*, 14-*n*



III. 13-*n*, 14-*iso*



IV. 13-*iso*, 14-*n*



V. 13-*iso*, 14-*iso*

These four compounds must between them have the formulæ II–V. From the evidence given above (+)-equilenin must be II or III. Four hypotheses can be made and tested by the molecular rotation difference method, namely:

A	(+)-equilenin is	II;	(+)-*iso*-equilenin is	III.
B	,,	II;	,,	IV.
C	,,	III;	,,	II.
D	,,	III;	,,	V.

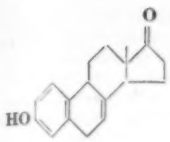
The Δ-values found above for compounds of known structure, and those calculated from the rotations of the equilenins on each of these hypotheses, are given in the following table.

		Δ_{13}	Δ_{14}
Found for compounds of known structure		−565	+214
Calculated from equilenins; hypothesis	*A*	−615	+167
,, ,, ,, ,,	*B*	+167	−615
,, ,, ,, ,,	*C*	−615	−167
,, ,, ,, ,,	*D*	+167	+615

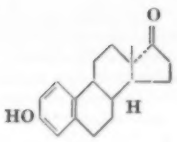
Clearly the only tenable hypothesis is *A*. Thus (+)-equilenin has the formula II, with the same *trans C/D* ring union as is present in the androgens, bile acids and sterols.

(+)-*iso*-Equilenin is therefore 14-*iso*-equilenin [III]. Chemical evidence for the correspondence of (+)-equilenin and (+)-*iso*-equilenin at C_{13} is also available; (+)-equilin [VI] was converted by Dirscherl and Hanusch[15] into (+)-equilenin and indirectly into (+)-*iso*-equilenin by Hirschmann and Wintersteiner[16] in conditions in which epimerization at C_{13} was most unlikely.

The evidence cited by Shoppee[3] for the stereochemical correspondence of (+)-œstrone and (+)-equilenin is not quite as convincing for C_{14} as it is for C_{13}, since epimerization at C_{14} might perhaps have occurred during the dehydrogenation of (+)-equilin [VI].



VI



VII

It is, however, very probable that (+)-œstrone has the 'normal' *trans C/D* ring union as shown in VII.

I have studied the molecular rotations of the doisynolic and marrianolic acids and of their bis-dehydroderivatives[4,5,17] in the hope of obtaining some evidence as to their configurations. The results give no indication in favour of any of the possibilities discussed by Shoppee[2] or by Heer and Miescher[4,5], and show the need for restraint in applying the method of molecular rotation differences, valuable though it is in dealing with certain groups of closely related substances. However, the evidence for a *trans C/D* ring union in (+)-œstrone and (+)-equilenin given in Shoppee's letter[3] and the present communication strongly supports the scheme outlined by Heer and Miescher[5] (at p. 553).

I am indebted to Dr. C. W. Shoppee for sending me a copy of his letter[3] before publication.

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[1] Barton, D. H. R., *J. Chem. Soc.*, 813 (1945); 512, 1116 (1946).
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p-Aminosalicylic Acid in the Treatment of Tuberculosis

The preliminary communication of Lehmann[1] on the treatment of human tuberculosis with *p*-aminosalicylic acid led us to undertake a detailed study of this acid. *p*-Aminosalicylic acid[2] is obtained by the reduction of *p*-nitrosalicylic acid, which itself can be prepared by a variety of methods[3]. These methods are uniformly laborious and we have consequently investigated alternative methods for its preparation. We find that direct carboxylation of *m*-aminophenol, using modified Kolbe conditions, gives *p*-aminosalicylic acid and not *p*-hydroxyanthranilic acid[4].

Clinical experience with the acid, which will be described in detail elsewhere, has amply confirmed and extended Lehmann's findings and has shown that the acid, which is well tolerated by man, is markedly effective in the treatment of pulmonary tuberculosis and of tubercular empyæma. A series of functional derivatives of the acid has been prepared, some of which are extremely active *in vitro* against the $H_{37}RV$ strain of *M. tuberculosis*.

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[1] *Lancet, N.Y.*, **250**, 15 (1946).
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A Modified Technique in Filter-Paper Chromatography

Various adaptations of filter-paper to chromatography have been published[1-4]; the following technique has advantages of simplicity of apparatus, speed, reproducibility, and particular suitability for micro-analysis. (Sensitivity approximately 2 micrograms solute.)

Two parallel cuts, about 2 mm. apart, are made from the same edge up to the centre of an 11-cm. circular filter-paper, and the 'tail' so formed, after bending at the joint perpendicular to the plane of the paper, and cutting down to approximately $1\frac{1}{2}$ cm., is immersed in the solution under analysis, contained in a capsule inside a Petri dish, which supports the filter-paper. A glass plate prevents evaporation.

By capillarity, the solution rises up the 'tail' and spreads circularly outwards. (Alternatively, the solution may be pipetted on.) The paper is then removed, and the 'tail' immersed in developing liquid, rate of development being controlled by tail-width and height of paper above liquid surface. Coloured solutions suitably developed give sharp separation of coloured rings.

In the case of colourless chromatograms, after development, a test sector is cut out and pressed between filter-papers impregnated with reagents giving coloured products with constituents of the chromatogram. Preparation of derivatives on the main chromatogram, which may be undesirable, is thus avoided.

Another method is based on the variation in rate of charring of the paper, caused by adsorbed substances: bands may frequently be detected by holding a test sector above a heated bunsen gauze.

After marking their positions on the main chromatogram and drying, the various bands may be cut out

and conveniently eluted by placing both ends of each curved strip on filter-paper soaked in eluent. Capillary action concentrates the adsorbate in the centre of the strip, whence it may be drawn off on paper or by capillary pipette.

A study of modified types of filter-paper in particular separations will be discussed more fully elsewhere.

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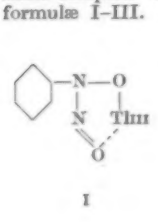
Inner-Complex Salts of Trivalent Thallium

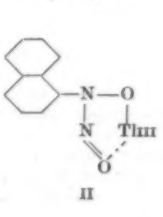
HITHERTO it has seemed that thallium was the only heavy metal with but slight tendency to form water-insoluble normal and inner-complex salts with organic compounds of acid character. Monovalent thallium gave insoluble salts with the mercaptans thioglycollic acid-anilid, thioglycollic acid-β-aminonaphthalid ('Thionalid')[1] and mercaptobenzthiazole[2]. Of these compounds only the first and second can be considered as inner-complex salts. Since thallium belongs to the same group in the Periodic Table as the inner-complex-forming metals gallium and indium, the existence of inner-complex salts of trivalent thallium was to be expected; and it has now been found that inner-complex salts of trivalent thallium with nitrosophenylhydroxylamine, α-nitrosonaphthylhydroxylamine, 8 hydroxychinoline, 5,7 brom-8 hydroxychinoline and 'Thionalid' can be obtained in the following manner.

Sufficient tartaric acid, citric acid or sulphosalicylic acid is added to a solution of thallium (Tl III) sulphate, bromide, etc., in order to avoid, by formation of complex thallic ions, precipitation after addition of ammonia. To the ammoniacal solution thus obtained, a solution of the complex-forming organic compound in alcohol or ammonia is added. Immediately precipitates of the respective thallic inner-complex salts are formed. The precipitations are quantitative, as in the filtrates no thallium can be detected by the usual tests.

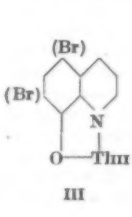
Precipitates with nitrosophenyl- and nitrosonaphthyl-hydroxylamine (white amorphous products) are also obtainable from mineral acids, non-masked thallic solutions. In this case the precipitate is mixed with the precipitant. The precipitates with 8-hydroxychinoline and 5,7 brom-8 hydroxychinoline (orange-coloured crystalline products) can also be formed from non-masked, acetate-buffered thallic solutions with alcoholic solutions of the reagents. The composition and constitution of the above inner-complex salts correspond to co-ordination formulæ I–III.



I

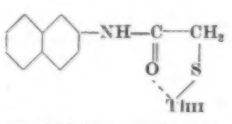


II

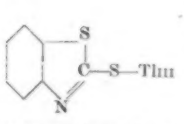


III

The precipitation with 'Thionalide', from ammoniacal-masked thallic solution, is white, whereas thallous 'Thionalid' is yellow. When precipitated with mercaptobenzthiazole, a yellow product (thallic compound) is formed, which in a few minutes is transformed into white thallous mercaptobenzthiazole and the disulphide of the mercaptan. The different behaviour of mercaptobenzthiazole and 'Thionalid' is obviously based on the fact that only the latter forms an inner-complex salt with trivalent thallium. Through chelate-ligation (IV) the trivalent thallium as well as the oxidizable mercaptan are stabilized. In the case of the normal mercaptobenzthiazole-salt V there is no stabilization by chelate-ligation, and therefore a redox reaction occurs, forming thallous mercaptobenzthiazole and the disulphide of the mercaptan.



IV. Stable inner-complex salt



V. Unstable normal salt

It seems that certain inner-complex salts of trivalent thallium can serve as a basis for new methods for the detection and determination of thallium.

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Order of Stability of Metal Complexes

IN a recent communication[1] it was pointed out that the order of stability of a series of internal metal complexes is substantially the same whether the metals are combined with bidentate chelate molecules like salicylaldehyde, glycine or 8-hydroxyquinoline. There is evidence from the results of other workers[2,3] that the same order is to be found with complex cations and with internal complexes formed with quadridentate chelate molecules. Cations containing ethylenediamine have been studied by Bjerrum[2,4] and Carlson, McReynolds and Verhoek[3]. From the accompanying table, which shows the overall stability constants for salicylaldehyde and ethylenediamine complexes, the similarity of order in the two cases is evident.

Bivalent Metal	log K_{sal}	log K_{en}
Pd	14·8	26·9(*a*)
Cu	13·3	19·6(*c*)
Ni	9·2	18·6(*b*), 18·1(*c*)
Co	8·3	13·8(*b*)
Zn	8·1	12·9(*d*), 12·1(*c*)
Cd	7·8	12·3(*d*), 12·1(*c*)
Fe	7·6(*a*)	9·5(*b*)
Mn	6·8(*a*)	5·7(*b*)
Mg	6·8	—

Abbreviations: sal = salicylaldehyde; en = ethylenediamine. (*a*) Recent measurements by the authors; (*b*) measurements by Bjerrum, ref. 2; (*c*) measurements by Carlson, McReynolds and Verhoek, ref. 3; (*d*) measurements by Bjerrum and Anderson, ref. 4. The figures for Cu and Pd in the right-hand column refer to complexes containing two molecules of ethylenediamine; all the other metals listed combine with three molecules of ethylenediamine.

If one metal complex is more stable than another of the same type, we should expect to find that, under suitable conditions, a metal will displace another from a less stable complex. By means of such displacement reactions, Pfeiffer, Thielert and Glaser[5] have investigated the relative stability of compounds formed with *bis*-salicylaldehyde-ethylenediimine. From a systematic study of reactions carried out in pyridine solution, Pfeiffer and his collaborators place the metals in the following order :

$$Cu^{II} > Ni^{II} > Fe^{III} > Zn^{II} > Mg^{II}$$

which, with one exception, is identical with the order in the table. That iron appears in a different position is almost certainly due to the fact that here we are dealing with Fe^{III}, whereas the other comparisons (in table) deal with Fe^{II}.

Owing to the fact that the reactions were carried out in pyridine solution, they are more appropriately regarded as exchange reactions, because the displacing metal is already in the form of a pyridine-containing complex ion. A typical reaction is :

$$[Cu(py)_4]^{++} + [Ni(sal\text{-}en)] \rightleftarrows [Cu(sal\text{-}en)] + [Ni(py)_4]^{++}, \quad . \quad (1)$$

where sal-en = *bis*-salicylaldehyde-ethylenediimine and py = pyridine. This point of view introduces a further complication in so far as the reaction would seem, at first sight, to show that the copper pyridine complex is less stable than the nickel pyridine complex, an order that would not be expected from the table. This raises the question: In what circumstances is one justified in drawing conclusions about relative stability from experiments of this kind ?

It may be shown that the equilibrium constant, K_1, for reaction (1) can be expressed in terms of the overall stability constants of the different complexes involved. Thus

$$K_1 = \frac{[Cu(sal\text{-}en)]\,[Ni(py)_4]^{++}}{[Ni(sal\text{-}en)]\,[Cu(py)_4]^{++}} = \frac{K_{Cu(sal\text{-}en)} \times K_{Ni(py)_4{}^{++}}}{K_{Ni(sal\text{-}en)} \times K_{Cu(py)_4{}^{++}}}$$

It has been observed[5] that reaction (1) goes practically quantitatively from left to right, which means that $K_1 \gg 1$. Under these conditions, we can then be certain that $K_{Cu(sal\text{-}en)} > K_{Ni(sal\text{-}en)}$ only if $K_{Cu(py)}{}^{++} > K_{Ni(py)}{}^{++}$. If, on the other hand, $K_{Ni(py)}{}^{++} > K_{Cu(py)}{}^{++}$, the relation between $K_{Cu(sal\text{-}en)}$ and $K_{Ni(sal\text{-}en)}$ is, from these observations alone, indeterminate. Pfeiffer *et al.* did not take into account the effect of the relative stability of the different pyridine complexes. We have therefore measured the stability constants of the pyridine complexes of copper and nickel, and have found that the copper complex is the more stable.

Although the co-ordination number (n) of Cu^{II} and Ni^{II} is frequently four, complex formation curves[2] indicate that as many as six pyridine molecules may be attached to the metal ions in solutions containing a large excess of pyridine. Approximate values of log K, where K is the overall constant, calculated on the assumption that $n = 6$, are 10·2 and 9·8 for the pyridine complexes of copper and nickel respectively. The chief uncertainty in the values of log K arises from the difficulty of measuring the constants for the last steps in complex formation. They are, however, sufficiently accurate to validate Pfeiffer's conclusions about the relative stabilities of the copper and nickel complexes of *bis*-salicylaldehyde-ethylenediimine.

Although it is not yet clear what determines the order of the metals in the series, it is perhaps worth noting that metals forming dsp^2 bonds (Pd^{II} and Cu^{II}) head the list. So far as the extreme members of the series are concerned, there is a hint that the basicity of the metal may have something to do with stability (the more basic the metal, the less stable its complexes); but owing to the difficulty of assigning numerical values to the basicity of metals[6], no definite statement relating the two factors is possible at present.

We are indebted to Mr. M. L. Hammond for assistance with measurements on the pyridine complexes.

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Polarographic Determination of the Gamma-Isomer of Benzene Hexachloride

We have found that, of the four known isomers of benzene hexachloride, only the gamma is reduced at a dropping mercury electrode. The insecticidal activity of benzene hexachloride is preponderantly due to the gamma-isomer, so that a method of determining the latter is of value in the analysis of benzene hexachloride and insecticidal compositions based on it. This property of the gamma-isomer, which was first discovered by us in 1945, permitted the development of a reliable analytical procedure. Keller *et al.*[1] showed in 1946 that benzene hexachloride gave rise to a polarographic wave, but did not specifically indicate that the wave was due to the gamma-isomer.

This is the sole instance known to us of only one isomer of a substance being reduced at the dropping mercury electrode, and is considered to be due to the polar structure of the gamma-isomer molecule[2].

The wave obtained is not quite a normal one as it appears to involve the progressive reduction, without a break, of three of the chlorine atoms in the molecule. This results in an extended rise in the current-voltage curve over the comparatively wide potential range of $-1{\cdot}15$ to $-1{\cdot}55$ volts *v.* sat. calomel electrode. Buffering at *p*H values lower than 7 is without effect on the slope of the wave; the latter is reproducible under standard conditions.

The residual and diffusion currents of the wave both exhibit an appreciable rise due to the presence of traces of other reducible materials in the crude benzene hexachloride. This rise in the residual and diffusion currents necessitates the use of an intersection method for the measurement of the wave height.

The conditions of solvent and base electrolyte which have been found to give the best waves are as follows :

Base solution :	Equal volumes of absolute alcohol and distilled water, containing 1 per cent of potassium iodide as electrolyte and 0·005 per cent of gelatin as maximum suppressor. Before recording, dissolved oxygen is removed from solution by a stream of hydrogen or nitrogen.
Recording range :	− 0·6 to − 2·0 volts *v.* sat. calomel electrode. The half-wave potential is − 1·35 volts *v.* sat. calomel electrode.
Concentration range :	0·005 to 0·04 per cent of gamma-isomer in the base solution.
Galvanometer sensitivity :	1/10 to 1/50 of full sensitivity using moderate damping. (Cambridge Instrument Co., Ltd., polarograph.)

Calibration is carried out by subjecting known concentrations of the pure gamma-isomer to a similar procedure and plotting the resulting wave heights against gamma-isomer concentrations. A straight-line curve is obtained which, when extrapolated to zero concentration, gives a small blank corresponding to a small residual current.

Absolute alcohol has been found preferable for the preparation of solutions, as reducible impurities present in the industrial solvent are liable to cause interference.

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Size of the Brain in the Ape-Man, *Plesianthropus*

Though the brain of the young *Australopithecus* is about 500 c.c. and that of the adult perhaps 600 c.c. or more, the brain of the type *Plesianthropus* about 450 c.c., and of the beautiful female skull about 415 c.c., it has been suspected that some male brains may have been very much larger. The Kromdraai skull has a brain that we estimated may have been about 650 c.c. ; but with little more than the temporal bone and the middle line as evidence the determination is not as convincing as one would like.

Recently we found an imperfect skull at Sterkfontein (skull No. 8) which has much of the top of the brain case and the nearly perfect base. Though the front of the frontal region is lost, we have part of one orbit preserved, and can restore the whole brain with considerable confidence. We give a side view of the brain as we restore it (Fig. 1). This restoration gives us a brain of about 530 c.c.

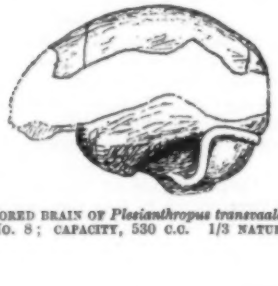

Fig. 1. Restored brain of *Plesianthropus transvaalensis* Broom, skull No. 8 ; capacity, 530 c.c. 1/3 natural size

Fig. 2. Side view of mandible of male *Plesianthropus transvaalensis* Broom, with the skull restored in outline. 1/3 natural size

Six months ago we discovered the very fine mandible of a large male. A preliminary account appeared in *Nature* of August 2, 1947. As the jaw is manifestly a male jaw and very much larger than must have been the jaw of the perfect female skull (No. 5), we said : "the male skull that belonged to this jaw must have had a brain of 600 c.c., or perhaps even 700 c.c.". Further development of the jaw shows that it was even larger than suspected. The right ascending ramus is nearly complete though crushed, and shows that it was broader than we had restored it. It is even broader than that of the Heidelberg jaw and much higher.

In skull No. 8, which has the 530 c.c. brain, the measurement from the base of the crown of the third upper molar to the back of the glenoid cavity is 63 mm. The skull belonging to this large mandible must have had a corresponding measurement of about 94 mm. It thus seems probable that the brain belonging to this large jaw had a capacity of well over 700 c.c. and perhaps more than 750 c.c.

From the collection of *Plesianthropus* skulls we now have, it is manifest that there is a very great degree of variation not only in size but also in structure ; but as all have been found in a space of about 120 cubic yards, it seems highly probable that all belong to one species. Perhaps we may be right in assuming that the female brains vary from 400 to 600 c.c., and male brains from possibly 600 c.c. to perhaps more than 750 c.c.

We know that *Plesianthropus* had a pelvis that was essentially human, and we can be sure that it walked on its hind feet and used its hands for the manipulation of tools and weapons. If some of the males had brains of perhaps 750 c.c., we can say with confidence that, if *Plesianthropus* was not quite human, it was nearly human.

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Jan. 31.

Nicotinic Acid in Human Blood Cells at Birth

THE nicotinic acid was determined in blood from the umbilical cord, and in blood taken from the mother at the time of birth. The cord blood was obtained by allowing the placental end of the cord to drain into a centrifuge tube containing a mixture of ammonium and potassium oxalates, and the blood was mixed with the oxalates as gently as possible to prevent haemolysis. The maternal blood was taken from the antecubital vein a few minutes later and mixed with the oxalates in a similar way. The cells were separated by centrifuging the blood for 15 min. at 3,000 r.p.m. and the nicotinic acid was determined in the cell mass by the method of Klein, Perlzweig and Handler[1].

The following results were obtained:

Subject	Nicotinic acid (μgm./c.c. of cells) Maternal blood	Cord blood
A	13·5	12·0
B	12·8	13·4
C	16·2	15·1
D	12·2	12·6
E	12·8	13·0
F	13·0	13·3
G	10·6	12·3
Average	13·0	13·1

No consistent difference was found in the concentration of nicotinic acid in the two kinds of cells. The average concentrations were in the range usually accepted as normal for the blood cells of adults.

The work of Lwoff, Morel and Digonnet[2], who used the *Proteus* technique for their estimations, suggested that the newborn child did not possess any large store of nicotinic acid. These investigators even went so far as to say that the tissues of the infant probably contained smaller concentrations than the same tissues of the mother; but the evidence for this statement was not conclusive. Blood was not investigated, and the present work perhaps throws some doubt on the accuracy of the previous observations, which, as Clements[3] has pointed out, certainly need confirmation.

Human breast milk is a comparatively poor source of nicotinic acid, and the newborn child may need more than it can obtain from this source. If so, it may be able to synthesize the vitamin from tryptophane (Sarett and Goldsmith[4]), or it may have to rely on bacterial synthesis in the gut. An attempt is being made to find out whether such synthesis occurs, and if so, how soon it begins.

This work is being carried out at the Landesfrauenklinik, Wuppertal, through the courtesy of the director, Prof. A. Anselmino, and with his very helpful co-operation.

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Nov. 15.

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Effect of Removal of Neurosecretory Cells in the Brain of Adult *Calliphora erythrocephala* Meig.

IN a number of insects neurosecretory cells have been found in the brain[1]; but very little is known of their function. Wigglesworth[2] showed that in *Rhodnius* the moulting hormone is produced by the pars intercerebralis of the protocerebrum, in which part of the brain Hanström[3] had detected neurosecretory cells. Recently, C. M. Williams[4] has found that neurosecretory cells in the brain of *Platysamia cecropia* play an important part in the regulation of the pupal diapause. (I am indebted to Prof. Williams for permitting me to quote this result.)

In the adult insect, the corpus cardiacum and probably the corpus allatum are innervated from the pars intercerebralis of the protocerebrum. In *Leucophœa* (*Blattaria*) B. and E. Scharrer[1] found that colloid could be traced from the secreting nerve cells in the pars intercerebralis to the corpora cardiaca all along the nervus corporis cardiaci. This morphological evidence renders it highly probable that the neurosecretory cells of the brain in some way influence the function of the corpus cardiacum and possibly that of the corpus allatum.

In *Calliphora*[5–6], as in several other insects, the presence of the corpus allatum was found to be necessary for the production of yolk in the egg. If the neurosecretory cells of the brain influence the function of the corpus allatum, it might be expected that removal of these cells would have an effect similar to that of allatectomy.

Owing to their light-bluish colour, the neurosecretory cells in the pars intercerebralis of the protocerebrum can be distinguished in the living *Calliphora*. The neurosecretory cells were removed from forty-nine *Calliphora* females five to eight hours old (at 25° C.); thirty-nine flies of the same age served as operated controls. The flies were fed on meat, sugar and water for seven days (25° C.) before they were dissected. The length of the biggest egg-chambers was measured. The result was clear: the egg-chambers of the twenty-two surviving females deprived of the neurosecretory cells measured 0·13–0·17 mm., whereas only two of the surviving twenty-eight controls had egg-chambers measuring 0·17 mm. and 0·18 mm., while of the remaining twenty-six controls, two flies oviposited, seventeen contained ripe eggs, and in seven flies the egg-chambers measured from 0·28 mm. to 1·25 mm., all egg-chambers containing normal yolk. No yolk was present in the egg-chambers of the flies lacking the neurosecretory cells (as a rule no yolk is deposited until the egg-chamber reaches a length of 0·25–0·30 mm.).

In twelve females, allatectomized at the same age and kept for seven days (25° C.), the length of the egg-chambers varied from 0·14 mm. to 0·23 mm., and no yolk was present in any of them (ref. 6, p. 357). Thus it is evident that the ovaries of the flies deprived of their neurosecretory cells only develop to the same, or nearly the same, stage as the ovaries of allatectomized flies. This result seems to indicate that the corpus allatum is activated from the neurosecretory cells, possibly through the corpus cardiacum.

As neurosecretory cells have also been found in the brain of dipterous larvæ, one might go a step further and suggest that the larval corpus allatum

likewise is controlled by the neurosecretory cells of the brain. The investigation is being continued.

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Dec. 6.

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Ribose Nucleic Acid in the *Drosophila* Egg

Caspersson and Schultz[1,2] have claimed that the presence of an extra *Y*-chromosome in the female *Drosophila* is correlated with an abnormally high concentration of ribose nucleic acid or allied substances containing the pyrimidine ring in the cytoplasm of oocytes. Their graph, based on quantitative determinations of ultra-violet light absorption, indicates that *XXY* oocytes contain about 40 per cent more ribose nucleic acid than do *XX* oocytes. If confirmed, this claim would be evidence for the control exercised by heterochromatin over the synthesis of ribose nucleic acid: and since this substance seems to be closely associated with protein synthesis, the argument might be extended to include a specific connexion between heterochromatin and growth-rate determination.

Brachet[3] has recently described a simple microchemical method whereby ribose nucleic acid may be estimated quantitatively. The tissue under examination is hydrolysed and distilled in a current of steam. Furfural, the hydrolysis product of ribose sugar which appears in the distillate, is assayed colorimetrically, making use of the coloured compound which it forms with aniline and acetic acid.

Caspersson and Schultz's contention is not directly open to chemical proof since the collection of a homogeneous batch of *Drosophila* oocytes is impracticable. However, freshly laid eggs can be collected in quantity and these assayed for ribose content.

Such eggs were collected over hourly intervals from the matings $XX \times XYY$ and $XXY \times XY$. They were dechorionated *en masse* and fixed in a mixture consisting of equal parts acetone and 10 per cent trichloro-acetic acid. After prolonged extraction in changes of fixative, the eggs were desiccated at 100° C., extracted with hot ether to remove neutral fat, hydrolysed and distilled. Furfural yields gave the following ribose nucleic acid assays:

	Weight of ether-extracted eggs (mgm.)	Yield of furfural (γ)		Estimated ribose nucleic acid (mgm. per gm.)
	5·9	11·3		6·48
	6·5	13·1		6·82
	6·6	13·5		6·94
Eggs from *XX* females	6·6	11·6		6·00
	7·0	13·3		6·45
			Average	6·54
	4·9	9·6		6·61
	6·5	11·7		6·11
	6·7	12·7		6·41
Eggs from *XXY* females	7·1	13·1		6·25
	8·7	19·0		7·39
			Average	6·55

From these figures it is evident that there is no significant difference in the ribose nucleic acid content of newly laid eggs deriving from *XX* and *XXY* parent flies. In keeping with this result it should be further mentioned that in other experiments, to be described in detail elsewhere, no difference either in developmental-rate or in oxygen consumption was found to exist between these two types of eggs.

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Dec. 11.

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Trypanosoma heptatretæ sp. n., a Blood Parasite of the Hagfish

HITHERTO the occurrence of a trypanosome in the blood of the hagfish *Heptatretus cirrhatus* (Bloch and Schneider, 1801) seems to have escaped notice. The type slide of *Trypanosoma heptatretæ* was prepared from the peripheral blood of a hagfish found stranded at Island Bay, Wellington. Seventeen (57 per cent) of thirty hagfish so far examined have been infected with this hæmoflagellate. One infection was so heavy that an average of three trypanosomes were present in each field when freshly drawn blood was studied under oil immersion (1·8 mm.) and a × 10 ocular.

Trypanosoma heptatretæ is of long, slender form, its body tapering to a point posteriorly. Its dimensions, from the measurement of one hundred specimens fixed with 4 per cent osmic acid vapour and stained with Giemsa's stain, are as follows:

	Average	Range
Length of free flagellum	21 μ	18–24 μ
Length of body	61 μ	56–65 μ
Total length	82 μ	75–86 μ
Width of body at nucleus	3·0 μ	2·8–3·1 μ
Width of undulating membrane	2·5 μ	2·3–2·7 μ
Diameter of karyosome	2·3 μ	2·0–2·5 μ

The length of the free flagellum averages 37 per cent (30–43 per cent) of that of the body. The nucleus lies 40 per cent (35–44 per cent) of the body-length from the root of the free flagellum, and occupies almost the entire width of the body. A parabasal body is situated 5 per cent (4 – 7 per cent) of the body-length from the posterior end, and the axoneme terminates at a blepharoplast immediately anterior to this structure.

T. heptatretæ also occurs in a very much scarcer stout form which has the free flagellum much shorter than that of the common form described above. The body is correspondingly lengthened and very markedly widened, but the overall length is not increased. In this stout form the nucleus is appreciably larger than in the slender form, and occupies a more central position. Measurements of the only three specimens encountered to date give the average length of the free flagellum as 12 μ and that of the body as 70 μ. The width of the body at the nucleus averages 6·3 μ, while the diameter of the nucleus itself is 4·6 μ and that of the karyosome 3·3 μ.

In both slender and stout forms the nucleus is of circular shape, and contains a large central karyosome. The space between karyosome and nuclear membrane appears as a clear, vacuolated ring in living specimens. With Giemsa's stain, used either after dry fixation with absolute alcohol or wet fixation with 4 per cent osmic acid vapour, the karyosome takes on a purplish-pink colour. The vacuolated

ring between it and the nuclear membrane stains a light pink. Hæmatoxylin-stained preparations show the karyosome as a violet-stained body somewhat smaller in relation to the overall size of the nucleus as compared with Giemsa preparations.

The cytoplasm of the parasite stains a deep blue with Giemsa. It is dense, vacuolated and intensely granular, the granules staining purplish-black. As in *Trypanosoma granulosum* Laveran and Mesnil (1902), a parasite of *Anguilla vulgaris*, the granules are not apparent in hæmatoxylin preparations when the stain is properly extracted[1].

T. heptatretæ resembles *T. granulosum* in the granular nature of its cytoplasm, but is distinguished from this species by its circular nucleus and karyosome. These structures are very prominent in both stained and living specimens.

A more detailed account of *T. heptatretæ* is in course of preparation.

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Relationship of Glioma to Encephalitis in the Domestic Fowl, and an Associated Parasitic Agent

THE occurrence of glioma in the brain of the fowl was reported by Belmonte[1] (one case) and by Jackson[2] (two cases). Later, Jungherr and Wolf[3] studied two cases and concluded that the tumours were astrocytomas. During the past twelve years I have had the opportunity of studying some fifty cases of the disease from material submitted by Prof. D. Coles of this Institute.

The histopathological observations led me to the following conclusions. (1) In the fowl, all gradations occur between lesions of chronic disseminated focal encephalitis and glioma, often in the same brain. (2) The histopathology of these chronic encephalitic foci is identical with that of the brain tissue at the margin of glioma—hypertrophy and hyperplasia of blood-vessels, perivascular infiltration (chiefly by lymphocytes, plasma cells and monocytes), and overgrowth and proliferation of astrocytes. (3) Avian glioma enlarges chiefly through progressive incorporation of these astrocytes into the tumour tissue—'growth by conversion' (of neighbouring cells to 'tumour cells'). (4) I cannot agree with Jungherr and Wolf (*loc. cit.*) that the multiplicity of the lesions in avian gliomatosis is due to cellular metastasis. I believe that each tumour arises as a focus of encephalitis.

These findings suggested that avian glioma is a response to some noxa which continues to spread in the brain tissue in advance of the tumour; not a 'purposeless' proliferation of cells.

A survey has been made to determine whether this disease might be associated with the presence of a visible biological agent, with the result that the following bodies have to be described briefly, with arbitrary designations for convenience of further communications.

A-bodies (Fig. 1): In sections these appear as oval or circular rosettes composed of an inconstant number of oval units (A^1-bodies), which radiate in orderly fashion around a central space, are readily

Fig. 1 Fig. 2

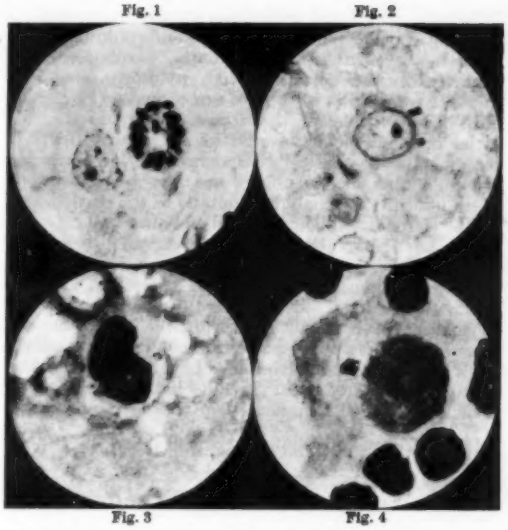

Fig. 3 Fig. 4

Fig. 1. *A*-BODY AT THE MARGIN OF A FOCUS OF CHRONIC ENCEPHALITIS. (ASTROCYTE NUCLEUS NEAR BY)

Fig. 2. *C*-BODIES (OVAL AND DOUBLE OVAL) IN THE CYTOPLASM OF A TUMOUR CELL. (GLIOMA)

Fig. 3. RING-SHAPED *C*-BODIES IN A MONOCYTE; OTHER FORMS ALSO VISIBLE. (SMEAR FROM GLIOMA)

Fig. 4. JUXTANUCLEAR, VACUOLATED *D*-BODY IN A HYPERTROPHIED ASTROCYTE. (BRAIN SMEAR—CHRONIC ENCEPHALITIS)

(ALL STAINED WITH GIEMSA. × 1200)

stainable with nuclear dyes, and are Feulgen-positive. *A*-bodies may measure 10 μ in diameter (in smears, 18 μ); the A^1-bodies about 2·5 μ × 1·75 μ. The latter can be seen in process of dispersion from the rosettes into the tissues. *A*-bodies have been seen in glioma and in chronic encephalitis, but are rare and quite unreliable of demonstration. But in two cases of more acute or purulent encephalitis they were present in large numbers.

B-bodies: These represent the immediate precursors of *A*-bodies and there are all transitional stages. A somewhat refractile membrane encloses a central chromatic mass which later resolves into the *A*-rosette. They could be confused with a poorly fixed mitotic metaphase of a tumour cell. Their distribution is similar to that of *A*-bodies.

C-bodies: Much smaller elements, resembling small piroplasms or even *Rickettsiæ*. In both glioma and chronic encephalitic foci they can be demonstrated with considerable constancy if Giemsa-stained sections or smears are carefully searched. Oval, double-oval, piriform, bipolar and ring-forms are distinguishable (Figs. 2 and 3).

D-bodies (Fig. 4): Juxtanuclear, irregularly oval, moderately chromatic, in some respects reminiscent of Negri-bodies. They may be attached by a fine stalk to the nuclear membrane of a tumour cell or of an infiltrating cell. Typically they cause a shallow indentation in the nucleus. Unreliable of demonstration in fowl glioma.

It is my opinion that all the above bodies represent phases of a specific parasite. A pronounced tendency to the emergence of the *A*-body phase is associated with a purulent inflammatory reaction, whereas phases such as the *C*-bodies are associated with a more chronic reaction, the ultimate stage of which is a glioma.

Several additional bodies are strongly suspected of being still other phases of this pleomorphic parasite: *E*-bodies are intensely chromatic, torula-like, and can readily be confused with pyknotic nuclei or nuclear fragments. *H*-bodies are composed of chromatin and cytoplasm, the former with bipolar, tripolar or quadripolar distribution. They are likely to be dismissed as cells undergoing karyorrhexis. Possible filamentous phases are also being studied. Full descriptions, including details of the distribution in the tissues, will be published elsewhere.

I believe that glioma of the fowl will prove to be nothing but a proliferative response to a specific infectious agent.

These findings led me to approach Dr. R. A. Krynauw, head of the Neurosurgical Department of the Johannesburg Hospital, for collaboration in the task of ascertaining whether they have application also to gliomas of man. Results have been obtained which will be communicated in the near future.

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Jan. 15.

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Shrivelled Wheat Grain from Rust-Affected Crop as Seed

IN the Central Provinces and Berar and other regions in peninsular India, recurrent damage is caused to the wheat crop by black stem rust, *Puccinia graminis tritici*. In some years, as in 1946, the destruction of the crop is so great as to result in an acute shortage of seed. To investigate the possibility of utilizing the shrunken grain produced by the rust-affected crop, as seed, germination tests of, and experiments to observe the effect on yield of sowing, such grain were carried out.

Samples of shrivelled grain were obtained from different places and individually sorted into three grades according to grain size: medium, thin and very thin grains. Percentages of each grade in a sample and its 1,000-seed weight were ascertained before testing viability of the grain. Due to high weather temperature (about 115° F.) and for want of a refrigerator at this Station, germination tests were carried out in small earthen pots filled with sand and clay. The pots were partially buried in wet sand and kept in a cool room during the day, and removed to the open towards evening. The

TABLE 1. SUMMARY OF THE RESULTS OF GERMINATION TESTS
(Figures represent the mean for the number of samples tested per lot.)

Lot No.	Number of samples tested	Percentage of grades*			1,000-grain weight in gm. of grades†			Germination percentage of grades		
		A	*B*	*C*	*A*	*B*	*C*	*A*	*B*	*C*
1	24	19	68	13	18·5	10·9	5·3	79	63	33
2	20	34	58	8	15·3	8·9	3·8	84	80	66
3	11	16	70	14	18·4	10·5	5·1	97	79	62
4	30	27	66	7	16·5	8·6	3·7	94	90	81
5	15	33	56	11	17·9	10·4	4·1	80	81	74
6	9	36	41	23	14·7	8·7	4·6	86	78	71
7	6	41	53	6	22·0	11·2	4·7	69	58	41
8	5	35	57	8	18·0	11·0	5·2	66	51	37
Average of 120 samples		30	59	11	17·7	10·0	4·6	82	73	58

* Grade *A* = medium grain; Grade *B* = thin grain; Grade *C* = very thin grain.
† 1,000-grain weight of normal wheat grain of the varieties tested varies from 36 to 40 gm.

TABLE 2. YIELD OF GRAIN (CALCULATED) PER ACRE (IN LB.)

Year	Variety	Shrivelled seed	Normal seed	Difference	Percentage loss
1944–45	*A*115	377	864	487	56·3
	*A*090	461	755	294	38·9
	*N.P.*52	472	588	116	19·6
		(*S.E.* 64·7; *C.D.* 188·7)			
Average		437	736	299	38·3
		(*S.E.* 37·4; *C.D.* 108·9)			
1945–46	*A*115	693	1205	512	42·5
	*N.P.*52	701*	1092	391	35·9
		(*S.E.* 94·7; *C.D.* 285·3)			
Average		697	1149	452	39·2
		(*S.E.* 66·9; *C.D.* 201·7)			

Critical difference (*C.D.*), at $P = 0{\cdot}05$. The differences are statistically significant.
* There was considerable damage to the plants by termites in these plots.

results of 120 samples thus tested are summarized in Table 1.

In order to observe how the crop grown from shrivelled grain would compare with that from normal seed, particularly in respect of yield, the two kinds of grain of three varieties, *A*090, *A*115 and *N.P.*52, were sown in plots, each 10 in. × 7½ in. in size and replicated six times. In the subsequent year, the trial was repeated but with the last two varieties. In both years the early growing period was dry and devoid of rain, resulting in seedling mortality which was approximately 20 per cent greater in plots sown with shrivelled grain. Plants from the normal seed were superior in growth, vigour and tillering. The yields obtained are shown in Table 2.

The results of germination tests indicate that shrivelled grains obtained from the rust-affected wheat crop are tolerably suitable as seed, particularly if the very thin grains are sorted out and rejected. From the point of view of yield, however, sowing such grain would lead to a loss of about 40 per cent as compared to that of the normal seed crop. As the seasons during which the trials were conducted were very adverse, it is probable that the loss would be less under favourable weather conditions. In the present circumstances in India, when good seed is not available, the possibility of importing it from outside is remote and the necessity of growing food crops is supreme, recourse could be taken to the use of shrivelled grain as seed.

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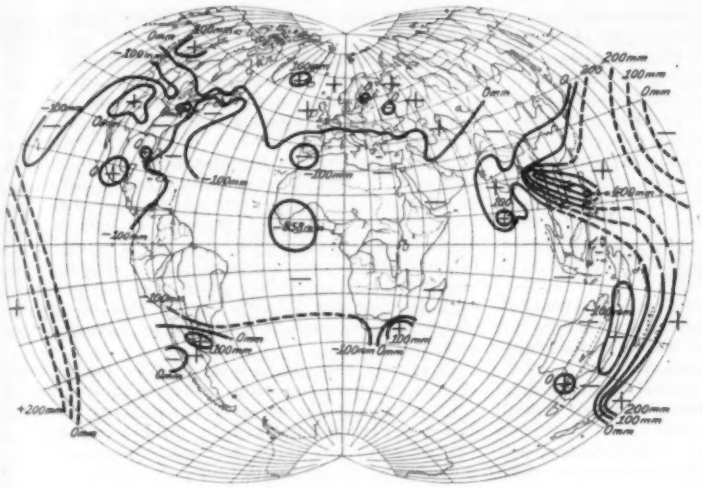
Recent Climatic Fluctuations

SOME researches have been carried out in order to elucidate recent climatic fluctuations. Maps have been constructed, showing for the whole earth: (1) the extension of severe winters and mild winters, cool summers and warm summers, cold years and warm years; and (2) the difference $T_{(1911-40)} - T_{(1881-1910)}$, $R_{(1911-40)} - R_{(1881-1910)}$ and $P_{(1911-40)} - P_{(1881-1910)}$ respectively; T, R and P are the normals of temperature, rainfall and pressure for the periods 1881–1910 and 1911–40, January, July and year.

Temperature-, rainfall- and pressure-curves have been worked out for 10-year means and overlapping 30-year normals respectively.

Certain regions seem to be connected in respect of climate, in that considerable positive or negative correlations can be found between the departures from the mean winter- and summer-temperature at the meteorological stations in these regions.



VARIATION OF RAINFALL, $R_{(1913-40)} - R_{(1881-1910)}$, mm.

Over great parts of the earth, especially in temperate and arctic zones, both winter- and summer-temperature seem to have been subject to an appreciable increase, while over other parts, especially in the tropical and subtropical zones, a decrease of temperature has taken place. Also an increase in rainfall is recorded over great parts of the temperate and arctic zones and over the monsoon regions of south-east Asia, while a decrease of rainfall is recorded over other tropical and subtropical regions, such as Africa, Australia, Brazil and the United States (see accompanying map).

A full account of this investigation will probably be published in the *Geografisk Tidsskrift*, Copenhagen, shortly.

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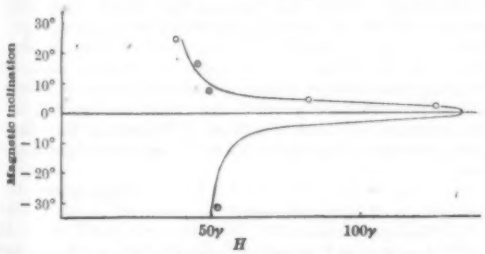
Daily Variation of the Horizontal Magnetic Force at the Magnetic Equator

IN a communication on the daily magnetic variation to the Edinburgh meeting, 1936, of the Association of Terrestrial Magnetism and Electricity, A. G. McNish[1] states that the establishment of the magnetic observatory at Huancayo has led to the discovery of a daily variation of the horizontal force (H) "markedly different from those expected for such a region", the amplitude being more than twice the value found from the analysis of S. Chapman.



VARIATION OF TOTAL RANGE OF THE VARIATION OF H WITH MAGNETIC INCLINATION

McNish has based his investigation on the assumption that the daily variation depends on magnetic co-ordinates, and points out that the daily variation of the declination varies considerably in a very narrow region at mag. lat. 0. The great daily variation of H at Huancayo is explained as an augmentation of the normal varying field originating from special circumstances. For Huancayo this augmentation, which is increasing when the distance of the magnetic equator from the geographic equator is increasing, is great.

The present note gives the results from an examination based on the assumption that the daily variation depends on the distance of the place of observation from the magnetic equator (magnetic inclination = 0). The examination is made for H using the total range of the daily variation for all days (September) corresponding to mean sunspot number. The data are given in the table, namely, names of observatories, geographic co-ordinates, magnetic inclination and the total range of H.

TOTAL RANGE OF DAILY VARIATION OF H

Station	φ	λ	Mag. inclination	Total range
Alibag	18·6° N.	72·9° E.	24·4°	38·5 γ
Antipolo	14·6 ,,	121·2 ,,	16·2	45·5
Madras	13·1 ,,	80·2 ,,	7·6	49·5
Kodaikanal	10·2 ,,	77·5 ,,	4·3	82·5
Batavia	6·2 S.	106·8 ,,	− 31·6	52·3
Huancayo	12·0 ,,	284·7 ,,	2·3	125·0

In the accompanying diagram the variation of the total range of H with the magnetic inclination is given. The application of geomagnetic co-ordinates has been avoided in this case, for the magnetic field at the place—and not the magnetic field of the earth as a whole—is the deciding factor.

In accordance with the assumption, the curve has been drawn symmetrically to the line corresponding to the magnetic equator. The curve suggests the range is great only for a strip of land about 300 km. to both sides of the magnetic equator. This augmentation at the magnetic equator of the normal daily variation of H may therefore arise from a varying electric current flowing in a very narrow zone above the magnetic equator at a height of the same order as the E layer. The values of the total range for Huancayo and Kodaikanal are in agreement with the above explanation of the augmentation of the amplitude of the daily variation of H, but this is not the case as regards the values for Madras and Antipolo, for which observatories there seems to be no addition to the normal daily variation.

It should be added that E. V. Appleton[2] in a recent communication has shown the existence of a marked minimum in the F_2 layer critical frequency at mag. lat. 0. Possibly a connexion exists between this phenomenon and the augmentation of the variation of H at the magnetic equator.

However, more observations of the daily variation of H from stations near the magnetic equator are needed before a complete representation of the variation with the magnetic inclination can be given.

Further, it may be desirable to examine the special electric conditions in the atmosphere over the magnetic equator by means of radio investigations.

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Dec. 23.

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Citizenship and Current Affairs in Army Education

THE following observations may perhaps serve to allay certain misgivings expressed in your thoughtful and constructive leading article in *Nature* of February 21, dealing with Army education, at the "undue emphasis" placed by the Army Council on citizenship and current affairs in the recently announced Army Education Scheme (Interim Period).

In any system of education it is inevitable that, for purposes of analysis and administrative convenience, there should be division into categories, and into subjects. Thus, in the new Army Education Scheme, there are the broad divisions of general education and individual education, and the former is itself divided into subjects of primary instruction, with the addition of citizenship and current affairs. Despite these necessary divisions it is not intended that any category or subject shall be dealt with in isolation, but rather that all subjects shall combine to foster the development of the responsible and well-informed soldier-citizen. Training in citizenship, therefore, will be the student's concern not only in periods set apart for that purpose but also in those devoted to the ordinary subjects of the curriculum; conversely, the study of public affairs cannot proceed without, and indeed must to some extent be based on, attention to historical and geographical considerations, to mastery of the basic skills of general education, and to the part which science plays in the modern world.

The distinction is rather one of emphasis. The young soldier joining the Army is given a short initial course in citizenship and current affairs, provided he is not in more urgent need of special instruction in elementary reading and writing. This first course is part of his introduction to the Army. It seeks to explain the need for service and to awaken in him a realization of the responsibilities as well as the privileges of citizenship. Later, the emphasis swings in the direction of consolidating his general education in primary subjects, a process to which two thirds of the time available for compulsory education is devoted. After the first twelve months of service a further change of balance takes place, and for the next two years, for those who are staying on in the Army beyond the period of national service, citizenship and current affairs share together an equal place with instruction in primary subjects. Finally, after the third year of service, citizenship and current affairs remain the only compulsory subjects in the curriculum, though facilities in working hours will continue to be made available for the pursuit of voluntary studies (a position identical with that occupied from the start of their service by those exempt on educational grounds from the provisions of general education).

It will be seen from the above that training in citizenship is in a sense the hard core of the Scheme, forming thereby the most important single factor making for a balanced and integrated curriculum. Certain cogent considerations may be held to justify this choice. First, it is a theme particularly relevant to adult students, for the man, unlike the boy, can quickly be made conscious that he has a stake in the community; matters which in the schoolroom can only be considered in the abstract take on with the approach of adulthood a reality and a seriousness which only maturity and experience can give. Secondly, the war-time experiment of current affairs discussions together with systematic study of the "British Way and Purpose" gave, despite many imperfections, convincing proof that the product of such periods was valuable in the way of improved officer–man relationships as well as increased social awareness.

It is true that discussions of this nature cannot always be divorced from political considerations, since politics is the art or science of living in society. But the discussions must be conducted with good temper and objectivity, and party political bias is not allowed to dominate them. It is true, too, that present educational standards among the majority of young men and young women entering the Army are such as to lay emphasis on the need for careful and accurate presentation of information as a necessary preliminary to any exchange of views. This is not lost sight of, and it may be pertinent to mention in this connexion the valuable contribution in this field made by the B.B.C. in its current affairs broadcasts for the Forces—factual commentaries valuable either as the raw material of discussion or as briefing matter for the instructor.

There are two further, and perhaps less obvious, reasons why current affairs discussions may be considered to play a particularly valuable part in the Army Education Scheme. First, the regimental officer has a special responsibility in acting as chairman at such discussions. This cannot but have a potent effect in driving home his personal responsibility for the educational progress of his men; he has a definite part to play and is therefore in less danger of considering education as something apart from the normal life of the unit, something to be left to the specialist instructor. The basis of the Army is the unit, and the best laid educational plans can only come to full fruition as an expression of unit life and experience. Finally, the current affairs discussion group is not based upon an educational grouping; that is to say, it is not composed of individuals of approximately equal educational attainment but is a cross-section representative of the unit as a whole, since it is composed upon a platoon basis. There are thus brought together individuals differing widely in interest, occupation and intellect but united by the common bond of fellowship within their small community. That throughout the Army men and women should be meeting regularly in small groups, under the chairmanship of their own officers, to discuss together some current topic of common interest is surely expressive of our democratic way of living and is powerful for good in its opportunities for the development of those qualities of tolerance, fair play and understanding on which as a nation we set such store.

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ALKALINE PHOSPHATASE IN TASTE BUDS AND NASAL MUCOSA

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THE application of Gomori's (1939) technique for the demonstration of alkaline phospho-monoesterase to various organs and tissues of the body[1,2,3] showed the enzyme to be located in many hitherto unsuspected sites. In view of its association with the absorptive part of the alimentary tract, and since the process of tasting and smelling appear to involve an absorptive process, it was considered desirable to test for phosphatase in taste buds and olfactory mucosa. Pieces of tongue of bat (*Nyctalus noctula*), mouse, rabbit, monkey (*Cercopithecus griseus*) and human being, and pieces of mouse, rabbit and human olfactory and nasal (respiratory) epithelium were therefore treated by Gomori's technique.

In the bat's tongue, alkaline phosphatase was found in high concentration in patches of basal cells in the stratified epithelium. The only other sites where it was present were the taste buds themselves (Fig. 1), the gustatory pores, the gustatory hairs and, in some places, in the superficial epithelial cells surrounding the gustatory pore. So far as could be seen, all the cells in the taste buds gave a phosphatase reaction of equal intensity.

Fig. 1

Figs. 2, 4

Fig. 3

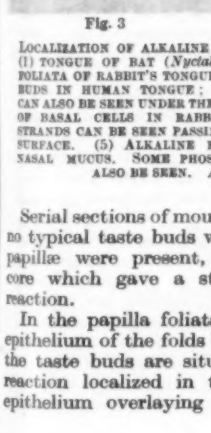
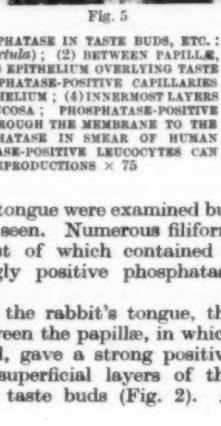


Fig. 5



LOCALIZATION OF ALKALINE PHOSPHATASE IN TASTE BUDS, ETC.: (1) TONGUE OF BAT (*Nyctalus noctula*); (2) BETWEEN PAPILLÆ, FOLIATA OF RABBIT'S TONGUE; (3) EPITHELIUM OVERLYING TASTE BUDS IN HUMAN TONGUE; PHOSPHATASE-POSITIVE CAPILLARIES CAN ALSO BE SEEN UNDER THE EPITHELIUM; (4) INNERMOST LAYERS OF BASAL CELLS IN RABBIT MUCOSA; PHOSPHATASE-POSITIVE STRANDS CAN BE SEEN PASSING THROUGH THE MEMBRANE TO THE SURFACE. (5) ALKALINE PHOSPHATASE IN SMEAR OF HUMAN NASAL MUCUS. SOME PHOSPHATASE-POSITIVE LEUCOCYTES CAN ALSO BE SEEN. ALL REPRODUCTIONS × 75

Serial sections of mouse's tongue were examined but no typical taste buds were seen. Numerous filiform papillæ were present, most of which contained a core which gave a strongly positive phosphatase reaction.

In the papilla foliata of the rabbit's tongue, the epithelium of the folds between the papillæ, in which the taste buds are situated, gave a strong positive reaction localized in the superficial layers of the epithelium overlaying the taste buds (Fig. 2). A reaction also occurred in a layer of cells deeper in the epithelium (shown in figure) in the upper part of the inter-papillary fold.

The monkey's tongue showed (like the bat) alkaline phosphatase concentrated in the taste buds. It was present also in the epithelium on the opposite side of the fold carrying the taste buds. In the bud itself, the central cells gave a stronger phosphatase reaction than the peripheral cells. The gustatory hairs were phosphatase-positive, and in some taste buds the distal ends of the cells gave a strong phosphatase reaction whereas the proximal parts of the cells gave a much less intense reaction.

Human taste buds did not appear to contain phosphatase (Fig. 3). This result might have been due to the fact that there had been some post-mortem degeneration of the cells (the specimen was 12 hours old). It was found, however, that there was no difference in the phosphatase reactions in the tongues of fresh or 12-hours dead rabbits, so presumably the absence of reaction in the human taste buds was not due to post-mortem changes.

The distribution of alkaline phosphatase in the human tongue resembled that of the rabbit, in that the reaction was concentrated in the superficial layers of the epithelium overlaying the taste buds. In those parts where the buds were separated from each other by a short space, it could be seen that the phosphatase was localized only in the epithelium surrounding the taste buds. In regions where the buds were close together, these areas linked up to form a continuous layer. The gustatory hairs appeared to give a positive reaction, and the walls of the gustatory pores gave a very dense reaction.

The distribution of phosphatase in the gustatory apparatus therefore appears to be of two types. Bat and monkey belong to one type, and human and rabbit to the other.

Olfactory mucosa of the rat gave a positive reaction for phosphatase, but the superficial cells of the epithelium gave only a slight reaction. The reaction was concentrated almost entirely in the lower layers of the basal cells. Beneath this basal layer were sparsely arranged phosphatase-positive cells, apparently ganglion cells, which gave off fine, greatly elongated, phosphatase-positive processes. Respiratory mucosa in the nose gave little or no reaction.

The olfactory mucosa of the rabbit was similar. As in the rat, the lower basal cells of the epithelium were strongly positive; but in addition, what appeared to be groups of three or four cells which were in contact with the basal layer extended through to the surface of the mucosa and gave as strong a phosphatase reaction as the basal cells. Parts of these strands can be seen in Fig. 4. There was also a thin line of phosphatase over the distal surface of some of the cells. Bundles of olfactory nerve fibres also gave a moderate positive reaction. (The strand at the bottom of Fig. 4 is such a bundle.) In some parts of the epithelium, these phosphatase strands appeared to be composed of one cell; but in others the strand seemed made up of three or four cells. It has not been found possible so far to differentiate these areas histologically from others in the nasal mucosa; they are not frequent enough to be the olfactory cells and it seems unlikely they represent ducts of Bowman's glands. Perhaps they represent a biochemical rather than an anatomical entity.

In the human olfactory mucosa the basal cells were almost completely phosphatase-negative, but

the distal columnar cells (both olfactory and sustentacular) were positive; olfactory hairs were also positive, but no more so than the bodies of the cells. A number of cells immediately beneath the basal cells and which appeared to be of a ganglionic nature gave off elongated processes with a phosphatase-positive reaction. Bundles of olfactory nerve fibres were negative.

In the non-olfactory epithelium, goblet cells were negative; other cells gave a slight reaction. Running along the outside of the free edge of the cells was a thin positive line, which was probably a line of mucus-containing phosphatase. Smears of human nasal mucus fixed in alcohol and incubated with the usual phosphatase substrate mixture gave positive results (Fig. 5).

Bowman's glands beneath the nasal mucosa showed both phosphatase-positive and phosphatase-negative acini. Most of the latter appeared to belong to the mucous category and the former to be of a serous nature.

The significance of these findings is not obvious at the moment. They show, however, that the membranes of the nose as well as those of the mouth are continuously bathed in alkaline phosphatase-containing fluids (saliva has for some time been known to contain the enzyme), and all substances requiring to be tasted or smelled must, therefore, pass through these fluids. Those being tasted must penetrate a further intra- or extra-cellular phosphatase barrier, either in the taste buds themselves or before the taste buds are reached. Such an arrangement may perhaps help to explain the mechanism of tasting of sugar, but it seems scarcely likely to explain why greatly unrelated chemical substances such as saccharine (*o*-benzoic sulphimide), *p*-phenetylurea, cinnamic aldehyde, certain aliphatic chlorides (for example, chloroform) and salts of lead and beryllium also taste sweet.

The piece of human tongue used was taken from the posterior position, a region which, like the tip, is sensitive to all the primary taste sensations; and the arrangement of the phosphatase was similar in all the taste buds examined, so it seems possible that phosphatase is not necessarily restricted to the buds concerned with the detection of any one of the primary tastes.

In view of the supposed similarity between the mechanisms of taste and smell, it is not surprising to find that substances to be smelled appear also to require to be passed through a phosphatase barrier; but the remarkable arrangement of phosphatase in the rabbit's nasal mucosa needs some explanation.

In addition to the chance of some connexion with the mechanism of taste and smell, there exists the possibility that the presence of phosphatase in the naso-buccal fluids may be concerned with some anti-infective mechanism. Thus it is of interest that it is the apparently serous alveoli in the Bowman's glands which contain phosphatase, and that in an acute infection such as a cold there is a great increase in serous secretion in the nose.

Full details of this work will be published elsewhere in due course. I am indebted to Dr. J. W. Sandells for the supply of human material and to Mr. J. King of the Bernhard Baron Institute, London Hospital, for the photomicrographs.

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DIETETIC HEPATIC LESIONS AND PROTEIN DEFICIENCY

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SEVERAL workers[1–14] have studied the hepatic lesions resulting from feeding deficient diets to experimental animals, and often produced fibrosis in the liver similar to that of human 'cirrhosis'. As a result of the recent researches a new orientation has been given to the etiology and treatment of liver diseases in general and 'cirrhosis of the liver' in particular. Himsworth, who has largely contributed to an understanding of this subject, in a recent monograph[17] has summarized the available evidence, both clinical and experimental, regarding nutritional factors in hepatic diseases.

Himsworth and Glynn[15,16] have distinguished two kinds of experimental dietetic injury in the liver, both of which resulted in hepatic fibrosis. Deficiency of protein (cystine) in the diet produced an acute massive hepatic necrosis, the survivors of which developed post-necrotic scarring and nodular hyperplasia. On the other hand, absence or deficiency of lipotropic factors in the diet, such as choline or methionine, resulted in fatty infiltration of the liver, which insidiously developed into diffuse hepatic fibrosis. By carefully devising the experimental diets, these workers were able to produce these two distinct lesions independently of each other. While there is general agreement that heavy prolonged fatty infiltration of the liver, however produced, leads to a diffuse hepatic fibrosis ('portal' or fatty cirrhosis), there is considerable disagreement regarding the production of acute massive necrosis and its sequelæ. Certain workers produce it consistently, others occasionally, yet others not at all. I personally have never been able to produce it in my laboratory in Bombay, although following closely the published directions. Since coming to England, however, I have seen it produced readily, and I have now amply satisfied myself of its occurrence, its dependence upon a low protein diet, and that it is, in fact, a true massive necrosis of the liver. It may, therefore, be of interest to record my experience in the hope of throwing some light upon the discrepancies between the results from different laboratories.

The incidence of 'cirrhosis of the liver' is high in certain parts of India, and it has been pointed out that "dietetic deficiencies appear to be the important factors in the causation" of the disease[18]. In view of its practical importance, an experimental investigation was undertaken under the auspices of the Indian Research Fund Association to study the role of nutritional factors in the production of hepatic cirrhosis. This investigation, which was commenced three years ago and is still in progress in the Department of Nutrition and Experimental Pathology, Haffkine Institute, Bombay, was designed to study the effect of continued feeding of diets containing varying levels of protein (5–18 per cent), and deficient in vitamins of the B_2 complex on the histological and biochemical changes in the liver of rats. Studies were also made on the effect of feeding low protein – high carbohydrate and low protein – high fat diets, and the effect of supplementing these diets with choline and methionine. Purified casein was used as the main source of protein, but in some experiments this was completely replaced by yeast protein. Either melted

butter-fat, hydrogenated groundnut oil or groundnut oil formed the fat ration in the synthetic diets.

An analysis of the material collected during the last three years showed two prominent features: first, absence of acute massive necrosis of the liver or its sequelæ, in animals fed on low protein diets (including those which received yeast as the main source of protein); and secondly, varying degrees of fatty infiltration of the liver insidiously developing into diffuse hepatic fibrosis with accumulation of 'ceroid'. Full details of this work will be published shortly.

While no explanation is forthcoming regarding the constancy of producing massive necrosis of the liver by dietary means, several factors, such as differences in the susceptibility of different strains of experimental rats, nature of yeast used as the source of protein, climatic factors (hæmorrhagic necrotic lesions, even in England, appear to be more easily produced in winter than in summer), differences in the intestinal flora of experimental animals, etc., have been suggested to explain the difficulties in the production of the lesion. It was further suggested that the presence or absence of tocopherol (vitamin E) in the basal diets may have an important bearing in preventing or inducing necrosis of the hepatic parenchyma[19,20]. The possibility of a superadded infection producing the periportal hæmorrhages and acute massive necrosis of the hepatic parenchyma requires further investigation.

But whatever the ultimate explanation of the causation of massive hepatic necrosis, two things are certain now. First, a lesion in every way similar to human massive necrosis of the liver has at last been produced in experimental animals; secondly, a state of protein deficiency is an essential, if not the only, factor in the development of the lesion. Having these certainties, and considering the great practical implications of this work to medicine, it is of urgent importance to resolve the discrepancies between the results obtained in different laboratories. The first step to this end is for the work to be repeated in all the laboratories concerned using, not merely foodstuffs that are reputed to be similar, but identical foodstuffs directly drawn from the same stocks as are in use in those laboratories where positive results are consistently obtained.

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MEASUREMENT OF 'ENVIRONMENTAL RESISTANCE' IN THE AUSTRALIAN PLAGUE GRASSHOPPER

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LABORATORY and field experiments have shown that the Australian plague grasshopper, *Austroicetes cruciata* Sauss, is well adapted to live in the particular climatic zone where it is found[1]. An obligate diapause in the egg-stage ensures that the grasshopper produces only one generation each year[2]. Eggs are laid during November and December (late spring and early summer), but never hatch before the following August or September. Thus the active stages are present during two or three months in the spring when the physical environment is least severe. For the remaining nine months, comprising the hot dry summer and cool wet winter, the insects are in the soil in the egg stage, which is well adapted to resist desiccation during the summer and high humidity during the winter.

Nevertheless, variability of the weather in the grasshopper belt is such that all stages of the grasshopper are exposed to the risk of occasional heavy mortality from physical causes. It has been possible to assess the chances of heavy mortality due to several components of the physical environment. The calculations are no more than first approximations, since they are based on arbitrarily selected parameters of the weather and not on the whole distribution of records of rainfall, temperature and humidity for the fifty years used in the calculations. But we give them because they may interest ecologists who are concerned with the quantitative study of animal populations. The data on which the calculations are based are given in full in the publications cited.

During heat waves, the soil in which the eggs are laid may reach a temperature of 60° C., and at the same time the relative humidity of the soil atmosphere may be as low as 10–20 per cent. Laboratory experiments and field observations have shown that the probability of high mortality due to the direct effect of such high temperature in the summer is quite small[3]. On the other hand, the chances of death from desiccation is much greater. The severity of the summer dryness makes this the most critical period for the egg, despite the fact that the egg is more resistant to desiccation during the summer than at any other stage of its development[4]. The mortality of the eggs in the summer is related to the longest dry spell within the months November to April. A 'dry spell' is defined as the number of days during which the soil moisture is below the 'wilting point'. In the very dry summer of 1940, there was 90 per cent mortality of eggs in the driest part of the grasshopper belt. There the longest period without rain lasted 80 days, and during this period the total evaporation was 40·6 in. This severity of dryness had been reached or exceeded from one to seven times in the last fifty years, depending on the district. Hence the probability that the mortality of eggs in the summer will exceed 90 per cent is of the order 2–14 per cent[3].

In the winter the eggs are least resistant to desiccation, but the chance of dryness or excessive wetness causing high mortality is quite remote. In the early spring, however, there is a critical period at the time the eggs are hatching. Eggs may hatch in soil well below the 'wilting point', but under these conditions the nymphs are unable to escape from the pod because of the caked lid entrapping them. By methods analogous to those described above, it was estimated that 'high' mortality from this cause might occur about twelve times in a thousand years[3].

Information on the influence of dryness in the spring on the mortality of nymphs and adults was obtained from a detailed study of the weather during 1940. In September of that year the grasshoppers hatched in plague numbers, but by October it was virtually impossible to find a grasshopper anywhere. It was estimated that droughts as severe as that in 1940 had occurred from three to five times during the past fifty years, depending on the district[5].

The calculations were made for several districts in the grasshopper belt. As an example, the figures for the district of Hammond are given in the accompanying table.

Stage	Cause of 'high' mortality	Probability of 'high' mortality
Egg in diapause	Desiccation during summer and autumn	0·10
Egg developing	Weather during winter and spring	nil
Nymphs in soil and about to hatch	Drought during August–September	0·01
Nymphs and adults (active stages)	Drought during spring and early summer	0·10
	Excessive humidity during spring	Not measured
Any stage	Any of above causes	0·21

Since the probability of a high mortality-rate occurring in any one year from any of the causes which have been measured is 0·21, the probability of this not occurring is 0·79. By expanding the binomial $(0{\cdot}21 + 0{\cdot}79)^n$, we can calculate the probability that any group of n years will contain 0, 1, 2 . . . n years in which high mortality will occur. For example, the probability that a sample of ten years will contain no 'high-mortality' year is 0·09; the corresponding figure for a sample of five years is 0·31. Within the limits of the parameters chosen, these figures give a quantitative measure of the favourableness of the environment for *A. eruciata*.

The table does not include any figures for parasitism or predation. Eggs are parasitized by a Scelionid wasp[6]; in the years studied, this did not exceed 1–2 per cent. Small numbers of eggs are also destroyed by a Bombyliid of the genus *Cyrtomorpha* and an unidentified Dermestid beetle. But the most important predators are birds, which feed on nymphs and adults. In years when grasshoppers are abundant, the population seems so vast in relation to the bird population that the percentage reduction in numbers of grasshoppers through predation is probably small. Observations in drought years suggest that predators may be important in causing heavy mortality in the isolated concentrations of grasshoppers that survive the drought. Food for the predators is then scarce and they are forced to seek out the remaining local situations where any grasshoppers remain. To this extent predation operates in the reverse direction to which parasitism would be expected to operate on a declining population[5].

The remarkable adaptation of the grasshopper to its semi-arid climatic zone enables it to build up a population over a number of years until drought causes a crash in numbers, both through its direct effect of desiccation on the grasshopper and indirectly through its effect on the food supply. The fact that grasshoppers and plants can continue to exist together in this belt must depend largely on the respite the vegetation is given in the ten months of the year in which the grasshopper is in the egg stage. So far as the grasshopper is concerned, the complete annihilation of nymphs in drought years is prevented by the existence of scattered niches, be they ever so small, where some food remains.

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RESEARCH IN INDUSTRY

WORKING PARTY REPORTS

UNLIKE the majority of the reports from other 'working parties' of the Board of Trade, that for the cutlery industry (H.M. Stationery Office, London, 1947, pp. 38. 1*s.* net) makes no specific recommendations for the organisation of research, although it suggests that much research could be co-ordinated with research in other industries, and that the co-operation of such organisations as the Production Efficiency Service of the Board of Trade should be very valuable. Its principal recommendation is the constitution of a tripartite Cutlery Board, all the members of which, including the chairman, would be appointed by the Board of Trade, one third of them from nominees of the employers' association, one third from nominees of the trade unions, and one third from independent persons outside the industry. This Board would presumably call on the assistance of the Department of Scientific and Industrial Research, as the industry is not wealthy and will need financial assistance for effective research. Suggestions for certain specific lines of research are appended to the report.

The 'working party' dealing with rubber-proofed clothing, in its report (H.M. Stationery Office, London, 1947, pp. 40. 1*s.* net), likewise makes no recommendation for the establishment of a fresh research organisation, although exercised both by the need for research in such neglected fields as those of machinery and ventilation, and by the need for rubber-proofed clothing manufacturers to show keener interest in the results of research already carried out, such as that on lighting, productive efficiency, the science of management, industrial psychology, and the development of new fibres. In advance of the setting up of any development council, trade organisations could do much by operating in conjunction with existing institutions, where relevant, such as the British Cotton Industry Research Association and the India Rubber Research Institute, to bring about a new attitude.

The 'working party' also suggests that the industry should consider making an early approach to the Department of Scientific and Industrial Research for advice and practical guidance in this field. An increasingly active interest in textile research and development, particularly new finishing processes, and also in the development of plastics, is a specific recommendation for action by the industry which indicates its past neglect and restricted outlook—defects possibly only to be corrected as the industry becomes conscious that it is a section or part of a larger industry.

The 'working party' for hand-blown domestic glassware, in its report (H.M. Stationery Office, London, 1947, pp. 143. 3*s*. net), devotes rather more attention to technical research and recommends consideration by the glass industry of the expansion of technical research for the whole industry by setting up a glass research association, which should have initially an annual income, including the contribution from the Department of Scientific and Industrial Research, of at least £25,000. The 'working party' recommends that the University of Sheffield should be asked to consider the possibility of permitting this research association to be established initially in the existing buildings of its Department of Glass Technology, and also of leasing some of the land belonging to the University, behind and adjacent to the present building, for the erection of new laboratories, etc., as the work of the Association develops. The research association should be provided with a staff separate from that of the Department of Glass Technology, although for a time the position of director of research might usefully be held by the head of the Department. The annual income of the research association should be increased within five years at most to about £50,000 to enable a machinery research and development section to be created.

From this recommendation there is one dissentient. While agreeing wholeheartedly with the view that greater facilities for co-operative research into glass and glass manufacture are urgently desirable, Prof. H. Moore does not entirely agree that the formation of a glass research association is essential. In his view, the existing Department of Glass Technology at the University of Sheffield, if properly staffed and financed, could make adequate provision for these additional research needs. It is pointed out in the report that the organisation and functions of this Department are very similar to those of a research association, differing chiefly in its constitution as a department of a university and in the inclusion of educational work. The value of this educational work is emphasized in the report, which notes that this Department is the only place in Britain where technical training for the glass industry is available; the close contact maintained with the industry through the other activities of the Department greatly enhance the value of that work, while the long-term postgraduate investigations proceeding in the Department ensure that its activities are not entirely engrossed in the solution of day-to-day problems or in short-term investigations.

The report itself scarcely supplies the data which would enable an outsider to judge between the merits of Prof. Moore's view and that of the majority of his colleagues; but economy considerations, particularly of man-power, might well provide a decisive reason for exploring the possibilities of his view first. Beyond this, however, in spite of the small size of the units in the hand-blown glass industry, development and extension of technical research in the individual factories is highly desirable, and one reason for welcoming the formation of a new trade association comprising all firms in this section of the industry is that it would enable more research to be done on co-operative lines in the factories themselves on their own special problems. In addition to emphasis placed on the early initiation of research on the development of new types of machinery and equipment for the industry, the establishment of a design centre for the industry as a whole, and all possible encouragement and assistance to the scheme for setting up in Edinburgh a department for advanced training and research in design for the glass industry, are other important recommendations; while in common with many of the other 'working parties', that for the domestic glassware urges the industry to refer to the Urwick Report on Education for Management, and make contact with the British Institute of Management, so that it can endeavour to draw its recruits for managerial positions from a wider field. Greater use of glass technologists who have graduated from the Department of Glass Technology at Sheffield, and further support both of the educational side of that Department and of the Society of Glass Technology, are specific recommendations.

FIFTH BRITISH EMPIRE FORESTRY CONFERENCE

GREAT BRITAIN, 1947

THE Fifth British Empire Forestry Conference met in London on Monday, June 16, 1947, and a Summary Report and Results and Reports of Committees have now been published (London: H.M. Stationery Office, 1947. Pp. 56. 1*s*. net). The opening meeting of the Conference was attended by Mr. Tom Williams, Minister of Agriculture and Fisheries, and Mr. Joseph Westwood, Secretary of State for Scotland. Lord Robinson was elected chairman, and Mr. D. Roy Cameron (Canada), Mr. A. P. F. Hamilton (India), and Dr. F. Y. Henderson (director, Forest Products Research Laboratory, England) were elected vice-chairmen. Seventy-one delegates, thirty-eight associate delegates, one honorary delegate and three guests—Mr. G. M. Hunt, director of the Forest Products Laboratory, Madison, United States, and Messrs. S. B. Show and J. D. B. Harrison, of the Forestry Branch of the Food and Agriculture Organisation of the United Nations—attended the Conference.

The proceedings were somewhat similar to previous conferences. A comprehensive agenda prepared by a standing committee on Empire forestry, after consultation with the various Empire forest authorities, was dealt with at sessions held in London and Oxford. Visits were also paid to the Forest Products Laboratory at Princes Risborough and to saw mills and timber yards in the neighbourhood of London. Part of the work consisted of visits to some of the extensive conifer forests under the management of the Forestry Commission, and some private woods in Northamptonshire, Dumfriesshire, and Darnaway, in the County of Moray. The Forestry Commission areas visited were East Anglia, Northumberland, Cumberland, Roxburghshire and the Black Isle in Ross-shire and Cromarty, and the Culbin Sands.

Thirty-six forest authorities presented statements on Empire forests during the War. These statements

have been drawn up with the view of giving as much accurate information as is at present available on the subject of the total area of forests; total volume of standing timber and increment; output of home-grown woods and of imports and exports for pre-war years, and each of the war years; and the effect of the war-time exploitation on forest capital and the future increment.

Owing to the very heavy war fellings made in countries both within the British Empire and outside, it is probable that accurate figures will not be available for some time to come. Moreover, in many of the forests under the Colonial Office, which are tropical forests containing numbers of different species of tree, very little is yet known about the actual volume present of commercially utilizable timber, and many of them have had to bear heavy war fellings in the accessible parts.

A most interesting paper was prepared by Mr. Lyle F. Watt, chief of the Forest Service, United States Department of Agriculture, entitled "The Forest Situation in the United States". Reports were made on the steps taken to carry out the resolutions of the 1935 Conference. These resolutions were nine in number, and for the information available the summary report should be consulted.

Technical committees were appointed as follows: (*a*) Land Use; (*b*) Forest Management, Sylviculture and Protection; (*c*) Forest Products Research; (*d*) Survey and Resources; (*e*) Education; (*f*) Timber Supply.

Various resolutions were drawn up by these different committees and submitted to the main Conference at its final meeting on July 19. The next Conference will take place in 1952, either in India or Canada.

MAGNETIC FIELD OF MASSIVE ROTATING BODIES

IT may be permissible to add a footnote to the much-discussed article by Blackett[1], in which he examines the proportionality which seems to exist between the magnetic moment and angular momentum of massive rotating bodies such as the earth, sun and stars. He suggested that this simple result must have some profound physical significance, but that it seemed very probable that a satisfactory explanation would not be found except within the structure of a unified field theory. The purpose of this note is to direct attention to the claim of Prof. J. Mariani, of the Princeton Institute of Advanced Study, to have provided such an explanation and such a unified field theory. Mariani's more accessible publications appeared in *C.R. Acad. Sci. Paris*, **206**, 1247 (1938); **211**, 430 (1940); **218**, 447 and 585 (1944); and "Electromagnétisme et relativité" (Cahiers de Physique Théorique, Paris, 1945), Part 1. However, the present summary has been prepared from his latest work, "Théorie des champs macroscopiques"[2], and a communication submitted to *Nature* for publication among "Letters to the Editors".

Mariani's latest treatment starts from philosophic considerations, akin to those of Kant, concerning the impossibility of knowing 'the thing in itself'. From the point of view of the average physicist, this is unfortunate. Even if he has the patience to read it, he may merely draw the depressing conclusion that no objective scientific measurement can exist. The next section of the work is something like a generalized theory of relativity, but with many coefficients that are quite indeterminate. Then suddenly, by means of a principle of identification, the treatment becomes much more definite. All the equations, except one, reduce to something like the ordinary gravitational theory of relativity. The one exception is the distinctive point of the theory, and its significance seems to be that a gravitational field must necessarily be accompanied by an electrical field.

The application of the theory to massive rotating bodies then proceeds very much on the lines of Sutherland, whose work is discussed in Blackett's article. The earth is supposed to have a positive volume charge compensated by a negative surface charge. This gives the desired proportionality between magnetic moment and angular momentum. The constant of proportionality is worked out for the earth, the sun, and the milky way, and shown to be of the right order of magnitude. It is also shown that for a copper sphere of radius 10 cm. making 200 revolutions per second, the magnetic field is too small to be observed. This agrees with the experiment of Swann and Longacre, also discussed by Blackett.

Those who are interested in the matter will wish to examine Mariani's arguments for themselves; they will probably find the four short papers in *Comptes Rendus* easier to understand than the fuller and more philosophic version.

H. T. H. PIAGGIO

[1] Blackett, *Nature*, **159**, 658 (1947).

[2] Théorie des champs macroscopiques. Par Jean Mariani. Pp. ii+98. (Paris: Centre de Documentation universitaire, 1947.) n.p.

RECENT SOCIOLOGICAL PERIODICALS

APART from the specialized field of economics, Britain has, until recently, suffered from a lack of journals devoted to the social sciences. The deficiency is now being made up by a variety of periodicals. *Pilot Papers*, as their subtitle of "Social Essays and Documents" suggests, usually take a wide sweep; but the number for June 1947 is devoted largely to American sociology. It contains a detailed review, by Dr. E. A. Shils, of recent American contributions to urban sociology, class stratification and race, family and small group problems, for which all students must be profoundly grateful. There is also an admirable study of the American child by Mr. Gorer, stressing the dictatorship of such factors as the 'scientific feeding schedule' and the fear of being thought a 'sissy'.

American-type sociology is distinguished by using induction from collections of observed fact rather than philosophical deduction. Its methods are thus more akin to those of the natural sciences than the methods of the sociology and economics mainly pursued in Europe. The facts observed may be opinions and attitudes, and one welcomes the first volume of the *International Journal of Opinion and Attitude Research*, edited by Prof. Radvany, of the University of Mexico, with contributions from H. D. Lasswell, Henry Link and Tom Harrisson. The facts observed may also be the behaviour of human beings one to another, and to study behaviour as well as attitudes, a new journal, Anglo-American rather than fully international, is being launched under the title of *Human Relations*. The first number contains an

intriguing article by the late Kurt Lewin, a leader in sociological thought and technique as yet almost unknown in Britain. To an equilibrium economist his reduction of such social situations as unhappy marriages, restriction of industrial output or aggressiveness among boys to an equation of conflicting forces must be interesting and flattering. *Human Relations* also contains a survey of prejudice in a seaside town, and studies of the civil resettlement of British prisoners of war, and of a scheme for residential management in treating difficult children. The theoretical essays are thus well balanced by articles descriptive of current procedures. Occasionally, as in an unnecessarily complicated account of a fairly simple experiment in industrial training, the writing is wordy and pedantic.

The wide field of contemporary social activity now being approached in the scientific mood is clearly illustrated in these current periodicals. Quite apart from their admirable American articles, *Pilot Papers* contain in the two numbers for June and September 1947 a much-needed analysis of bureaucrat behaviour, of B.B.C. 'third programme' listening and of the conception of progress in general (by Dr. Julian Huxley) and its practice in agriculture in particular. There are also first-hand experiences of service on a jury, the 'closed shop', and rent tribunal procedure. We look forward to further numbers of all these ventures in modern sociology. P. SARGANT FLORENCE

NORTHERN IRELAND FISHING INDUSTRY DEVELOPMENTS DURING THE WAR YEARS

PRIOR to the outbreak of the Second World War, the inhabitants of Northern Ireland exported to Great Britain most of the fish they caught, and imported from Britain most of the fish that they ate. During the war years, however, the consuming public became much more dependent on their own locally caught fish and only surpluses were exported.

In a "Report on Sea and Inland Fisheries", recently published by the Government of Northern Ireland*, these and other war-time changes are reported. As no figures of production and trade exchange could be published during the War because of the statistical 'blackout', this report includes tables for the six-year period 1939–44.

The developments that took place in the Northern Ireland fishing industry during the years under review are indicated by the fact that herring catches in 1944 totalled 50,895 cwt. as compared with 39,467 cwt. in 1938, and whiting catches rose from 17,061 cwt. in 1938 to no less than 64,619 cwt. in 1944. The total value of fish (excluding salmon) landed on the coast in 1944 was £258,427.

Taking all kinds into account, the quantities of sea fish landed in 1944 increased to approximately double the pre-war figure. The total number of fishing boats in Northern Ireland was 508 in 1944, a decrease of 51 boats compared with 1938. Motor boats, however, increased from 314 to 338 in this period, and vessels solely engaged in fishing increased from 109 to 149 in 1944. The number of men employed in sea fishing increased from 898 to 1,031, of which latter figure 555 were whole-time fishermen, the highest number to be so engaged since the year 1930. The chief factor in this increase in the number of fishermen was the main County Down fleet, which increased from 45 vessels in 1938 to 56 in 1944.

The report states that the scheme of loans and conditional grants authorized in 1941, combined with greatly increased earnings by fishermen, gave the necessary incentive for the replacement of older craft by vessels of modern design. By the end of 1944, a substantial number of new craft designed for herring fishing and seine netting was either in commission or under construction in spite of war-time shortages. In the years covered by the report, loans exceeding £24,000 were advanced by the Ministry.

There is also a year-by-year review of inland fishing. Reference is made to the fact that in several hatcheries artificial propagation of salmon was carried out. The year 1943 was the best pollan season in Lough Neagh since 1927. High prices in cross-Channel markets greatly helped to stimulate the activities of the freshwater fishermen. On account of the scarcity of fish in Great Britain, considerable impetus was given to the capture of coarse fish in rivers and lakes in Northern Ireland. In the Lough Erne district alone, the total exports of coarse fish in 1944 increased to almost a hundred tons.

* Report on Sea and Inland Fisheries, 1942–1944. Pp. 20. (Belfast: H.M. Stationery Office, 1947.) 1s. net.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Monday, March 22

ASSOCIATION OF APPLIED BIOLOGISTS (in the Botany Lecture Theatre, Imperial College of Science, South Kensington, London, S.W.7), at 11 a.m.—Discussion on "Biological Aspects of Water Pollution".*

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5.30 p.m.—Dr. K. M. Strom: "The Geomorphology of Norway".

INSTITUTION OF THE RUBBER INDUSTRY, MANCHESTER SECTION (at the Engineers' Club, Albert Square, Manchester), at 6.15 p.m.—Mr. T. J. Meyrick and Dr. J. T. Watts: "Polyisocyanates—some Applications in Bonding".

Tuesday, March 23

MANCHESTER GEOGRAPHICAL SOCIETY (in the Geographical Hall, St. Mary's Parsonage, Manchester), at 6.30 p.m.—Miss K. Speight: "Sicily, the Garden of the Mediterranean".

TEXTILE INSTITUTE, LONDON SECTION (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 6.30 p.m.—Mr. F. Courtney Harwood: "The History and Science of Washing".

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7 p.m.—Dr. N. P. Allen: "Some Techniques and Results in Metallurgical Research".

Wednesday, March 24

BRITISH SOCIETY FOR INTERNATIONAL BIBLIOGRAPHY (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 2.30 p.m.—Users' Questions on the Universal Decimal Classification Answered.

PALESTINE HOUSE (at 18 Manchester Square, London, W.1), at 5.45 p.m.—Dr. Clay Lowdermilk: "The Jordan Valley Scheme".*

ROYAL MICROSCOPICAL SOCIETY, INDUSTRIAL MICROSCOPY SECTION (at B.M.A. House, Tavistock Square, London, W.C.1), at 6 p.m.—Mr. H. L. Shipp: "The Microscopy of Food".

SOCIETY OF CHEMICAL INDUSTRY, NUTRITION PANEL OF THE FOOD GROUP (joint meeting with the BRITISH DIETETIC ASSOCIATION, at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6 p.m.—Dr. D. P. Cuthbertson and Miss R. M. Simmonds: "Special Dietary Requirements in Sickness and Convalescence".

SOCIETY OF DYERS AND COLOURISTS, MIDLANDS SECTION (at the Victoria Station Hotel, Nottingham), at 7 p.m.—Mr. G. H. Lister: "The Absorption of Acid and Chrome Dyes by Wool".

CHEMICAL SOCIETY, ABERDEEN SECTION (joint meeting with the LOCAL SECTIONS of the ROYAL INSTITUTE OF CHEMISTRY and the SOCIETY OF CHEMICAL INDUSTRY, at Marischal College, Aberdeen), at 7.30 p.m.—Prof. E. E. Turner: "Some Stereochemical Problems".

Thursday, March 25

BRITISH INSTITUTION OF RADIO ENGINEERS, MIDLAND SECTION (at the Technical College, The Butts, Coventry), at 6.30 p.m.—Mr. N. E. Head: "Methods of Measuring the Insertion Loss, Phase-Shift and Time Delay of Transmission Networks".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned :

LECTURER IN ANATOMY—The Registrar, The University, Sheffield (March 27).

ASSISTANT MANAGER (DEVELOPMENT) (Ref. No. F.176/48), SHOP MANAGERS (DEVELOPMENT) (Ref. No. F.177/48), a SHOP MANAGER (CHEMIST) (Ref. No. F.178/48), and a SHOP MANAGER (PLANT MAINTENANCE) (Ref. No. C.131/48), in the Department of Atomic Energy, Springfields Factory, Salwick, Preston—The Ministry of Labour and National Service, Technical and Scientific Register, Room 669, York House, Kingsway, London, W.C.2, quoting relevant Ref. No. (March 30).

STATISTICIAN (No. A92/48A), and a STATISTICAL OFFICER (No. A461/47A), in the Air Ministry—The Ministry of Labour and National Service, Technical and Scientific Register, Room 669, York House, Kingsway, London, W.C.2, quoting relevant Ref. No. (March 31).

ASSISTANT DIRECTOR (PHYSICS)—The Director, Gas Research Board, 1 Grosvenor Place, London, S.W.1 (March 31).

SENIOR EXPERIMENTAL OFFICER in the Ministry of Supply, London, to supervise the valve interests of the Signals and Radar Research and Development Establishments and the secretariat of Inter-Service Technical Valve Committees—The Ministry of Labour and National Service, Technical and Scientific Register, Room 669, York House, Kingsway, London, W.C.2, quoting D78/48A (April 3).

SENIOR RESEARCH OFFICER IN THE BIOCHEMISTRY SECTION of the Division of Industrial Chemistry, Melbourne—The Secretary, Australian Scientific Research Liaison Office, Australia House, Strand, London, W.C.2, quoting No. 1623 (April 10).

SENIOR RESEARCH OFFICER IN THE BUILDING MATERIALS RESEARCH SECTION, Melbourne—The Secretary, Australian Scientific Research Liaison Office, Australia House, Strand, London, W.C.2, quoting No. 1618 (April 10).

ASSISTANT LECTURER (Grade III) IN GEOLOGY—The Registrar, Queen Mary College, Mile End Road, London, E.1 (April 15).

CHAIR OF GEOPHYSICS in the University of Istanbul—The Director, Personnel Department, British Council, 3 Hanover Street, London, W.1 (April 15).

CHAIR OF ANGLO-SAXON ARCHÆOLOGY at University College—The Academic Registrar, University of London, Senate House, London, W.C.1 (April 16).

STATISTICIAN in the Department of Preventive Medicine—The Secretary and Registrar, The University, Bristol (April 17).

ASSISTANT LECTURER IN BOTANY (if possible with interest or experience in cytology and genetics), an ASSISTANT LECTURER IN ORGANIC CHEMISTRY, a LECTURER IN MATHEMATICS (with special qualifications in pure mathematics), ASSISTANT LECTURERS (2, one in Applied Mathematics and one in Pure Mathematics), an ASSISTANT LECTURER IN PHYSICS (preferably with experience in radar or geophysics), and an ASSISTANT LECTURER IN ZOOLOGY (preferably with experience in experimental cytology or genetics)—The Registrar, University College, Hull (April 17).

AGRICULTURAL ECONOMISTS (2), ASSISTANT AGRICULTURAL ECONOMISTS (3, Grade B), a LECTURER IN THEORETICAL PHYSICS, and an ASSISTANT LECTURER IN THEORETICAL PHYSICS—The Registrar, The University, Manchester 13 (April 17).

ENTOMOLOGIST in the Inter-Territorial Tsetse Reclamation Department, East Africa High Commission (Kenya)—The Under-Secretary of State, Colonial Office (Research Department), Palace Chambers, Bridge Street, London, S.W.1 (April 24).

LECTURERS (2) IN MECHANICAL ENGINEERING, and a LECTURER IN ELECTRICAL ENGINEERING—The Registrar, The University, Leeds 2 (April 24).

BRITISH COKE RESEARCH FELLOWSHIP tenable in the Department of Physical Chemistry—The Registrar, King's College, Newcastle-upon-Tyne (April 30).

TURNER DENTAL SCHOOL RESEARCH FELLOWSHIP, and the INTERNATIONAL WOOL SECRETARIAT SCHOLARSHIP—The Registrar, The University, Manchester 13 (April 30).

PROFESSOR OF BACTERIOLOGY in the University of Queensland—The Agent-General for Queensland, 409 Strand, London, W.C.2, or the Secretary, Universities Bureau of the British Empire, 8 Park Street, London, W.1 (Brisbane, May 31).

LABORATORY TECHNICIAN (Grade B.1, histological technique essential) IN PATHOLOGY DEPARTMENT—The Secretary, Welsh National School of Medicine, 10 The Parade, Cardiff.

AGRICULTURAL ECONOMIST, an ASSISTANT AGRICULTURAL ECONOMIST, and a DEMONSTRATOR IN PHARMACY—The Registrar, University College, Nottingham.

TECHNICAL ASSISTANT to assist in steelworks investigations, mainly in connexion with ingots and moulds—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1, quoting 'Ingots'.

SENIOR LABORATORY STEWARD—The Secretary, Northampton Polytechnic, St. John Street, London, E.C.1.

ASSISTANT BACTERIOLOGIST IN VACCINE LYMPH DEPARTMENT—The Bacteriologist-in-Charge, Lister Institute, Elstree, Herts.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Memoirs of the Cotton Research Station, Trinidad. Series B, Physiology, No. 18 : Studies on Foliage Hydration in the Cotton Plant, vii. The Size Factor. By T. G. Mason. Pp. 143–152. (London : Empire Cotton Growing Corporation, 1947.) 2*s.* 6*d.* [225

Economic Proceedings of the Royal Dublin Society. Vol. 3, No. 20 : Chick Mortality caused by War-Grade Wheat Offals. By Brendan J. Senior and Prof. W. Kearney. Pp. 293–310. (Dublin : Hodges, Figgis and Co., Ltd. ; London : Williams and Norgate, Ltd., 1947.) 2*s.* [225

Scientific Proceedings of the Royal Dublin Society. Vol. 24 (N.S.), No. 18 : On a Recent Addition to the Collection of Irish Meteorites in the National Museum, Dublin. By Prof. H. J. Seymour. Pp. 157–164 + 1 plate. 2*s.* Vol. 24 (N.S.), No. 19 : Irish Salmon, 1946. By Arthur E. J. Went. Pp. 165–178. 3*s.* Vol. 24 (N.S.), No. 20 : Salmon of the Kerry Blackwater. By Arthur E. J. Went. Pp. 179–188. 2*s.* Vol. 24 (N.S.), No. 21 : Effect of Mild Strains of Virus X on the Yield of Up-to-date Potato. By Phyllis E. M. Clinch and Robert McKay. Pp. 189–198. 2*s.* (Dublin : Hodges, Figgis and Co., Ltd. ; London : Williams and Norgate, Ltd., 1947.) [225

Foreign Office. Report of the Interdepartmental Commission of Enquiry on Oriental, Slavonic, East European and African Studies. Pp. 192. (London : H.M. Stationery Office, 1947.) 3*s.* net. [225

Report of the Ministry of Health for the Year ended 31st March 1946, including the Report of the Chief Medical Officer on the State of the Public Health for the Year ended 31st December 1945. (Cmd. 7119.) Pp. vi + 194. (London : H.M. Stationery Office, 1947.) 3*s.* 6*d.* net. [275

Medical Research Council. Special Report Series, No. 260 : The Bacteriology of Spray-dried Egg, with particular reference to Food Poisoning. By Various Authors. Pp. 66. (London : H.M. Stationery Office, 1947.) 1*s.* net. [275

University of Cambridge : School of Agriculture. Memoir No. 18 : A Summary of the Papers published by the Members of the Staff of the School of Agriculture and its Associated Research Institutes during the Period Oct. 1st, 1945–Sept. 30th, 1946. Pp. 28. (Cambridge : School of Agriculture, 1947.) 2*s.* [275

Education (Scotland). Report for the Year 1946 by the Director of the Royal Scottish Museum, Edinburgh. Pp. 16. (Edinburgh : Royal Scottish Museum, 1947.) [275

Ovaltine Research Laboratories. Annual Report (1946). Pp. 8. (London : A. Wander, Ltd., 1947.) [275

Liverpool Observatory and Tidal Institute. Annual Report, 1946. Pp. 14 + 3 plates. (Liverpool : Liverpool Observatory, 1947.) [275

Ministry of Agriculture and Fisheries. Bulletin No. 22 : Practical Soil Sterilization, with Special Reference to Glasshouse Crops. Fourth edition. Pp. iv + 22 + 10 plates. 1*s.* 3*d.* net. Bulletin No. 95 : Strawberries. Third edition. Pp. iv + 38. 2*s.* net. (London : H.M. Stationery Office, 1947.) [285

Other Countries

Indian Forest Bulletin. No. 130 : The Effects of Burning on the Soil as a Preliminary to Artificial Regeneration. By Dr. A. L. Griffith. Pp. iv + 34. 1.4 rupees ; 2*s.* No. 132 : The Price-Age Gradient of Bori (Hoshangabad, C.P.) Teak. By Bakhshi Sant Ram. Pp. v + 15 + 8 plates. 1.4 rupees ; 2*s.* (Dehra Dun : Forest Research Institute, 1946.) [225

Fieldiana : Zoology. Vol. 31, No. 11 : A New Race of Kokla Pheasant. By Robert L. Fleming. Pp. 93–96. 10 cents. No. 12 : Some Neuropterous Insects from Szechwan, China. By Nathan Banks. Pp. 97–108. 15 cents. No. 13 : A New Kinosternid Turtle from Colombia. By Karl P. Schmidt. Pp. 109–112. 10 cents. No. 14 : The Malleus (*Ossiculum auditus*) of the Anthropoid Apes. By Walter Segall. Pp. 113–120. 10 cents. No. 15 : Notes on Philippine Mosquitoes, ii, A New Species of *Tripteroides*. By F. E. Baisas. Pp. 121–124. 10 cents. (Chicago : Chicago Natural History Museum, 1947.) [225

Fieldiana : Zoology. Vol. 32, No. 1 : Phalangida from Tropical America. By Clarence J. and Marie L. Goodnight. Pp. 58. 75 cents. (Chicago : Chicago Natural History Museum, 1947.) [225

Smithsonian Miscellaneous Collections. Vol. 107, No. 1 : The Ethnogeographic Board. By Wendell Clark Bennett. (Publication 3889.) Pp. viii + 135. (Washington, D.C. : Smithsonian Institution, 1947.) [225

Report of the Science Service, Dominion Department of Agriculture, for the Year ended March 31, 1946. Pp. ii + 88. (Ottawa : King's Printer, 1946.) [225

Excerpta Medica : Fifteen Journals containing Abstracts of the World's Literature in the Field of Clinical and Theoretical Medicine. Section 1 : Anatomy, Anthropology, Embryology and Histology. 22 dollars ; £5.12.0 a year. Section 2 : Physiology, Biochemistry and Pharmacology. 45 dollars ; £11.3.0 a year. Section 3 : Endocrinology. 15 dollars ; £3.15.0 a year. Section 4 : Public Health and Social and Industrial Medicine. 22 dollars ; £5.12.0 a year. Section 5 : General Pathology, Pathological Anatomy and Bacteriology. 37.50 dollars ; £9.6.0 a year. Section 6 : Internal Medicine. 37.50 dollars ; £9.6.0 a year. Section 7 : Pediatrics. 15 dollars ; £3.15.0 a year. Section 8 : Neurology and Psychiatry. 22 dollars ; £5.12.0 a year. Section 9 : Surgery. 25 dollars ; £6.4.0 a year. Section 10 : Obstetrics and Gynaecology. 15 dollars ; £3.15.0 a year. Section 11 : Oto-, Rhino-, Laryngology. 15 dollars ; £3.15.0 a year. Section 12 : Ophthalmology. 15 dollars ; £3.15.0 a year. Section 13 : Dermatology and Venereology. 25 dollars ; £6.4.0 a year. Section 14 : Radiology. 15 dollars ; £3.15.0 a year. Section 15 : Tuberculosis. 15 dollars ; £3.15.0 a year. (Amsterdam : N.V. Excerpta Medica, 1947). [225

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